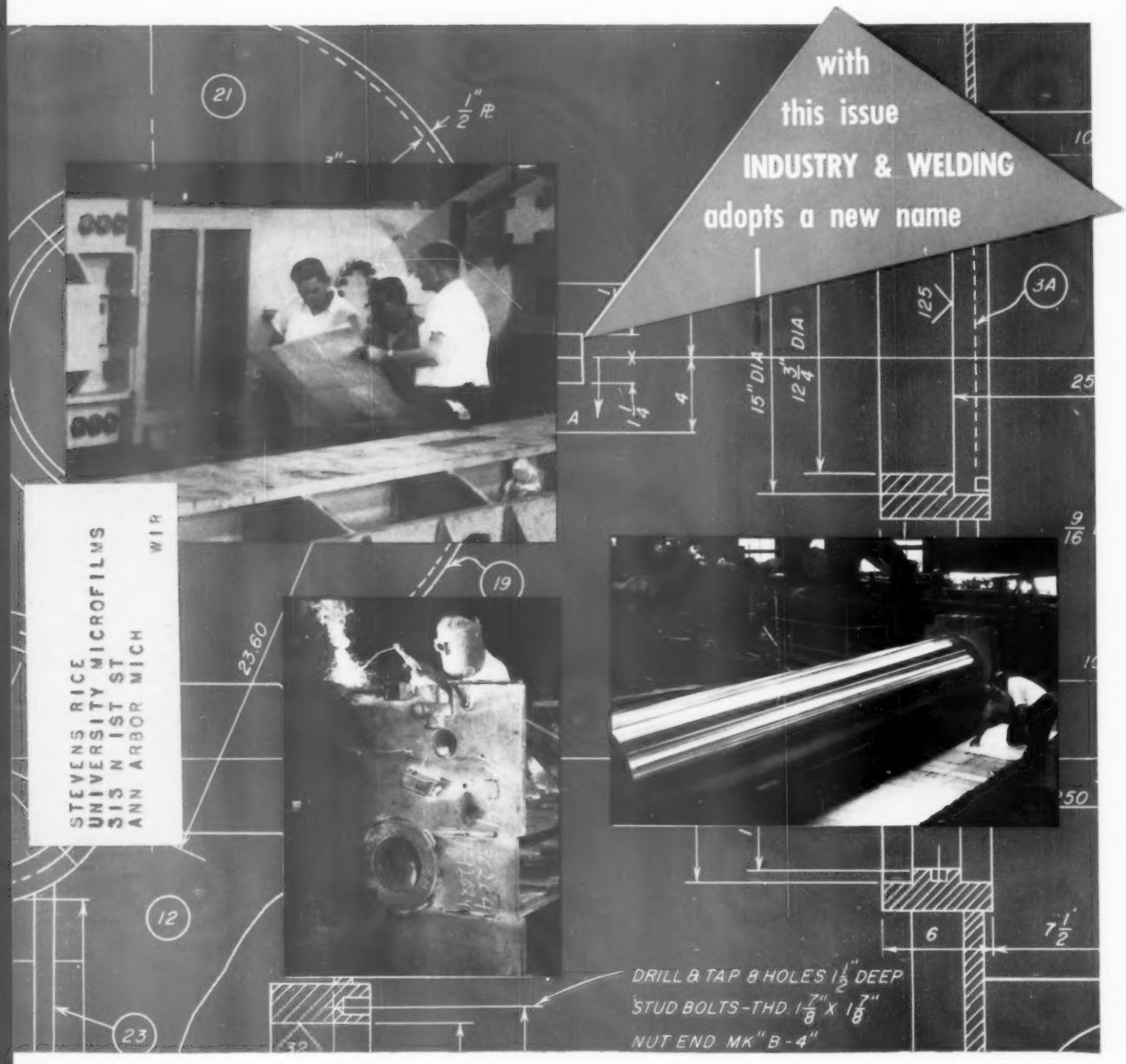
WELDING DESIGN & FABRICATION

JULY 1959

Established in 1930 as INDUSTRY & WELDING



The magazine of welding management, production, engineering

A THOUSAND AND ONE
Complete Units and Combinations

That's what is available to you from Jackson Products' well integrated line of safety products, including head, face, and eye protection for welding and allied industries.

Life Guard hat SH-3, the all-purpose hat for construction and electrical uses.

Fiber Glass hat SH-1, meets the tests for construction workers' safety hats.

Face Shield F-1, firmly held on Safety Hat SH-1 by elastic band.

Visors 15½ by 9" deep in clear plastic, tints of green. Visor with welding lens (shown on Musketeer) Visor 15½ by 9" deep of 24-mesh wire screen.

ALL JACKSON SAFETY HATS combine with **FACE SHIELD TYPE 'F-1'**

ALL JACKSON FACE SHIELD VISORS FIT FACE SHIELD 'F-1' (left) and 'MUSKETEER' (below)

Alumihat SH-5 gives excellent protection, is light in weight.

Two pivoted aluminum frame members permit raising visor.

Face shield J-1 shows 6" clear visor.

Metal-bound visors type J-1, 11¼" wide, 8", 6" and 4" deep; in clear plastic, .020", .030" and .040" thick, and in tints of green, .020" only.

Life Guard Cap SC-3, like the SH-3 hat, is made in white, yellow and grey

Cap-and-helmet SCH-1P shows curved shell helmet on SC-2 safety cap.

Cap-and-Goggle shows goggle unit CW-70 pivoted on SC-2 safety cap.

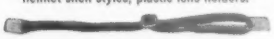
Musketeer Assembly No. 82 on Life Guard Cap SC-4 shows 34-2 visor, medium green.

ALL JACKSON SAFETY CAPS combine with **WELDING HELMETS IN NINE TYPES** with **GOGGLES IN FIVE TYPES** with **'MUSKETEER' FACE SHIELD**

Fiber Glass Cap SC-1, like the SH-1 hat, is made in grey and seven other colors.

Alumicap SC-5, like the SH-5 hat, is made in satin-finished aluminum.

'Winterizers' (left) may be used with all Jackson products shown here. Arc welding handshields (right) are available in all helmet shell styles, plastic lens holders.



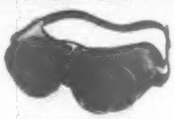
Chin Strap for Jackson safety hats and caps.

All three styles shown offer choice of three lens holders.

Curved shell helmet H1-AP shows plastic lens holder.

Narrow shell helmet H3-A shows metal lens holder.

Straight shell helmet H9-A shows plastic lift-front.



Supergoggles WR-70 for welding and GR-70 for grinding; elastic headbands.

Unigoggle W-60 for welding shows plastic headrest. WR-60 has elastic.

Goggles WR-50 for welding and GR-50 for grinding. Also in headrest types.

Musketeer Headgear Assembly 70-S shows Adjust-O-Lok, spark deflector, and clear visor No. 34-4, .040" thick.

Welding goggle type BX has plastic headrest and 2 by 4¼" filter lens.

Sold by Better Welding Supply and Safety Products Dealers

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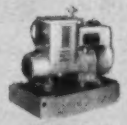
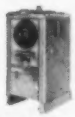

"Husky Boy"

AC/DC Welder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HOBART'S New ***"ROCKET 24"***
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Yes, each handful of "Rocket 24" electrodes you use will represent savings to you. These new contact type electrodes are heavily coated with iron powder that becomes part of the weld, for greater speed, strength and smoothness.

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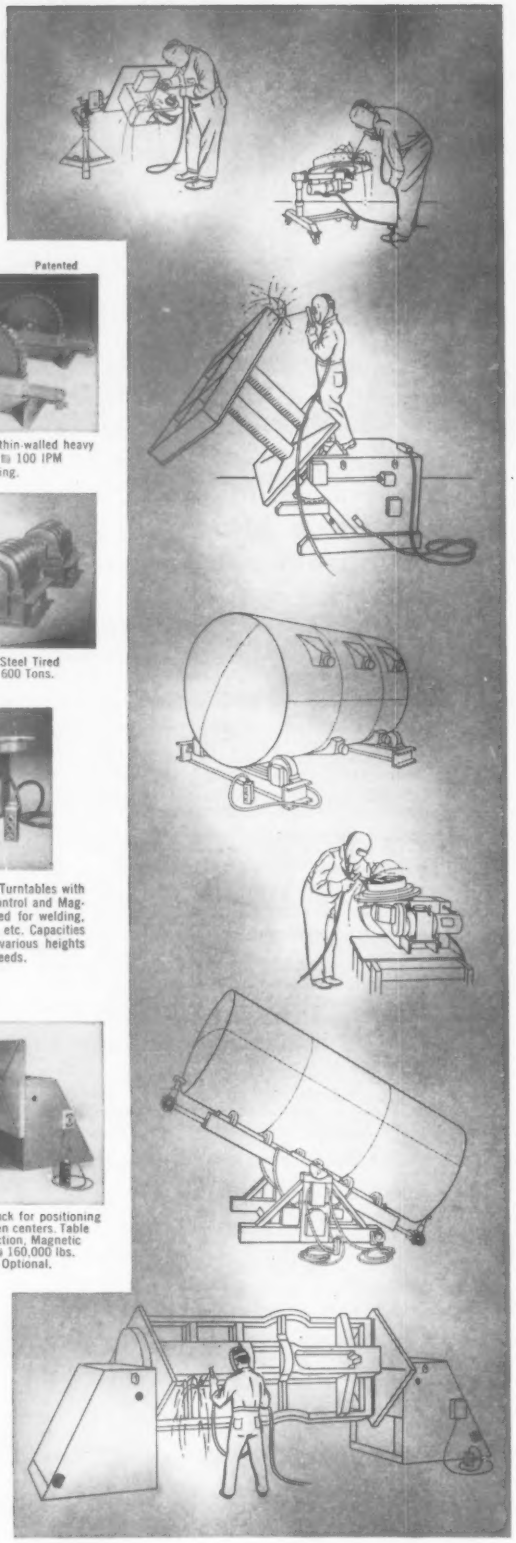

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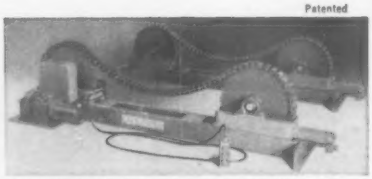

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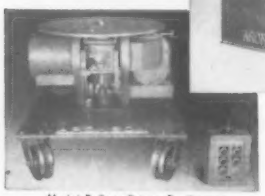

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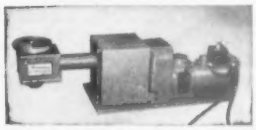

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Quality POSITIONERS by **Aronson MACHINE COMPANY**
ARCADE, NEW YORK

WORK WORK

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reader's guide to **WELDING DESIGN & FABRICATION** *for July, 1959*

The magazine of welding management, production, engineering

COVER: WELDING DESIGN & FABRICATION will cover the total welding management function: welding design, welding methods and the fabrication of weldments. Only by balanced integration of these three functions can the welding industry continue to grow. See page 29.

FEATURES

30 UNREASONABLE CODES DISCOURAGE WELDED DESIGN
Unrealistic standards discourage the use of welding in buildings, bridges and fabrications and hamper the redesign of castings and forgings.

32 JOINT DESIGN FOR AUTOMATIC WELDING
Good joint design minimizes cracking and porosity in consumable electrode welding a low alloy forged steel to a cast high temperature alloy.

35 COMPOSITE WELDED DESIGN HAS FLEXIBILITY
Welding permits using a variety of metals and metal shapes and thicknesses without increasing production costs.

36 ECONOMICS OF WELDED FABRICATION: Part III
Weldment design depends on standardization, on joint design and on stresses in parts under load.

40 FLASH WELDED FLAT STOCK IS COLD WORKED
Correct flash welding procedures and good joint preparation make possible high volume production of newly designed house trailer rims.

42 WELDING SIMPLIFIES MANUFACTURING AND MAKES ENGINEERING CHANGES EASY
Formed and machined steel parts, which replace castings, are welded with iron powder electrodes.

44 HOW TO SPECIFY JOINT CLEARANCE FOR BRAZING DISSIMILAR METALS
Nomograph eliminates time-consuming trial-and-error methods usually needed to determine proper joint clearance for brazing dissimilar metals.

48 KNOW YOUR FILLER METALS
An authority on the subject gives a clear and concise explanation of filler metal specifications.

51 DESIGN HINTS FOR USING WELDED STEEL TUBING
Tube wall thickness and the joint design are determining factors when spot and projection welding welded steel tubing.

54 CO_2 WELDING OF MILD AND LOW ALLOY STEELS
New dip transfer process makes possible economical welding of mild and low alloy steels in all positions.

60 "SHORT-ARC" WELDING OF THIN MATERIALS
New inert-gas consumable electrode process permits manual and mechanized welding of thin materials.

DEPARTMENTS

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Welding Fixture and Positioner Manufacturers Specify . . .

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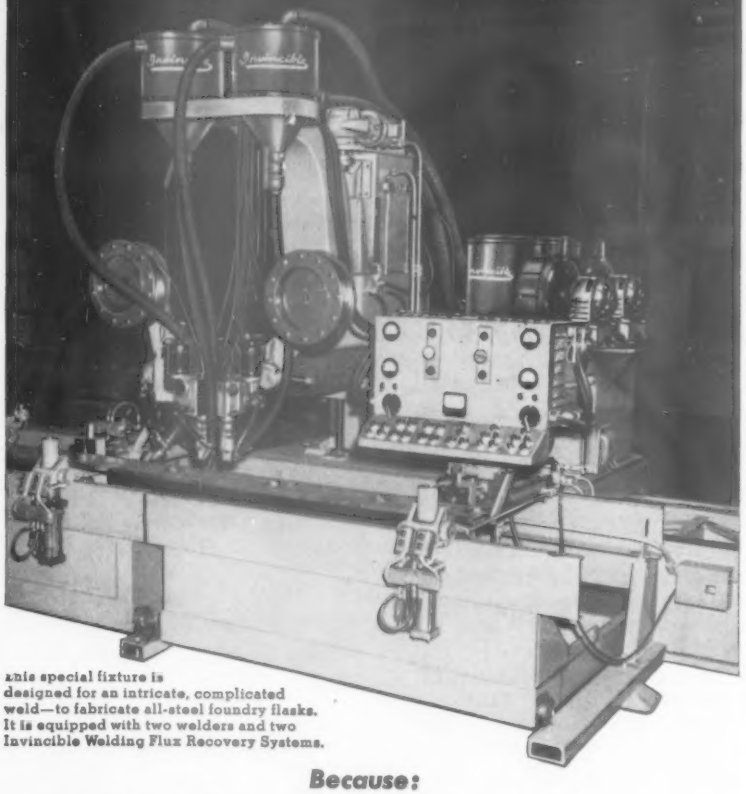

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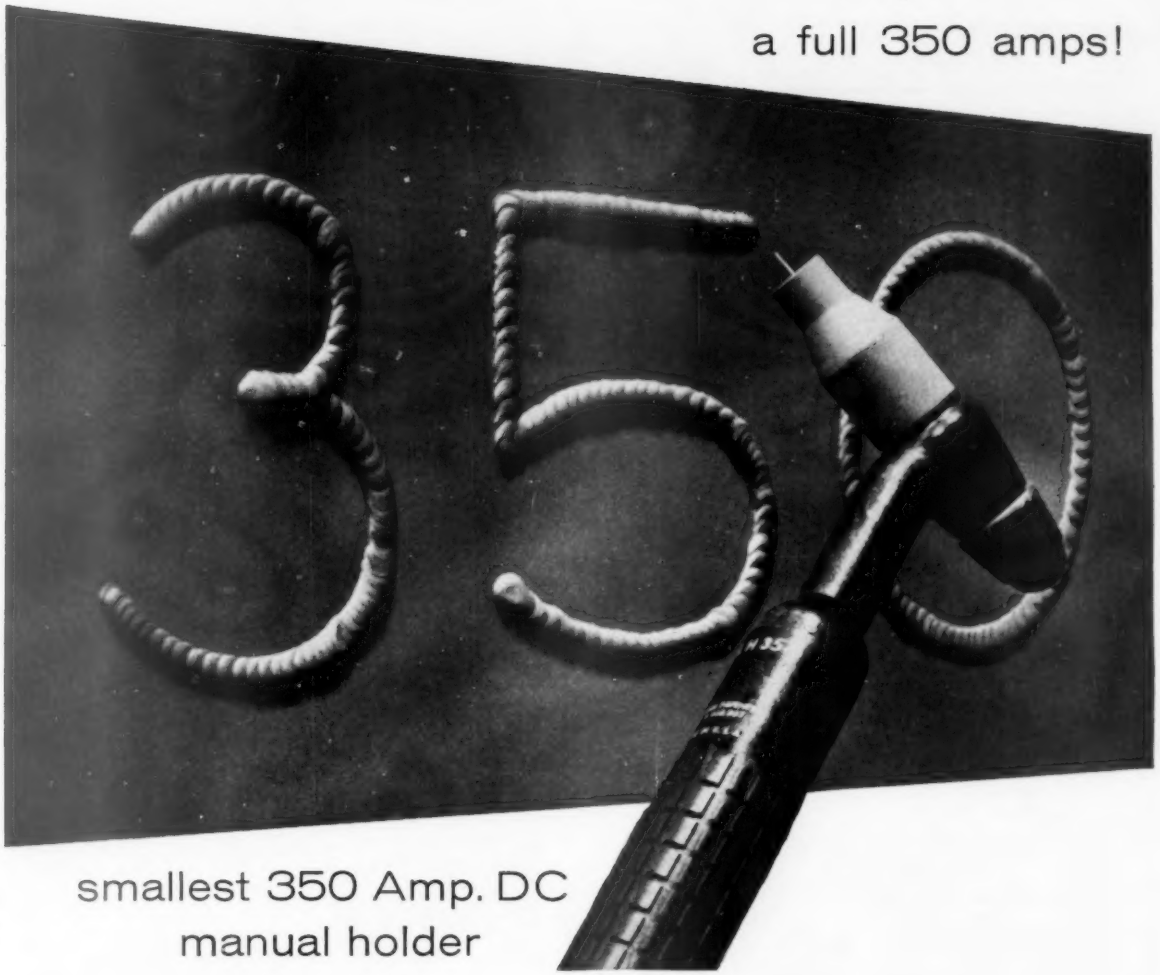

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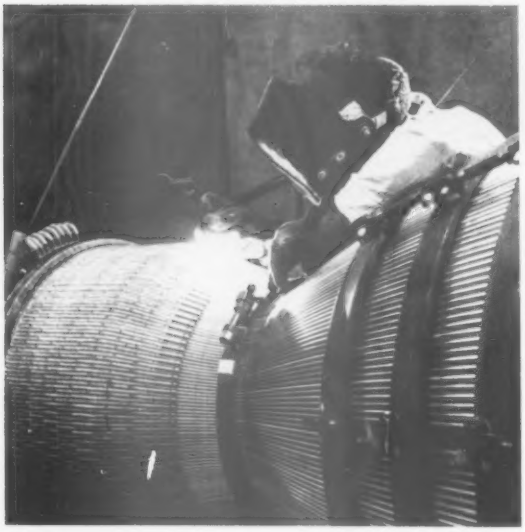
WELDING AT WORK

to do the job better and cheaper

Automatic brazing makes missile parts 90% faster

SCHENECTADY, NEW YORK: High-Frequency induction heaters used in a new automatic brazing and soldering facility developed by Raytheon have reduced by 90 percent the time formerly required for brazing and soldering operations in production of Sparrow III missile components. The new set-up has made possible a reduction in brazing and soldering time from three minutes to 18 seconds in the production of missile gyroscopes and accelerometers.

Operator presses starting buttons which lower bell jar over subminiature gyro parts. General Electric's high-frequency heater is used to braze and solder the gyro parts. Time, heat, gas and purge are handled automatically by electronic controls.

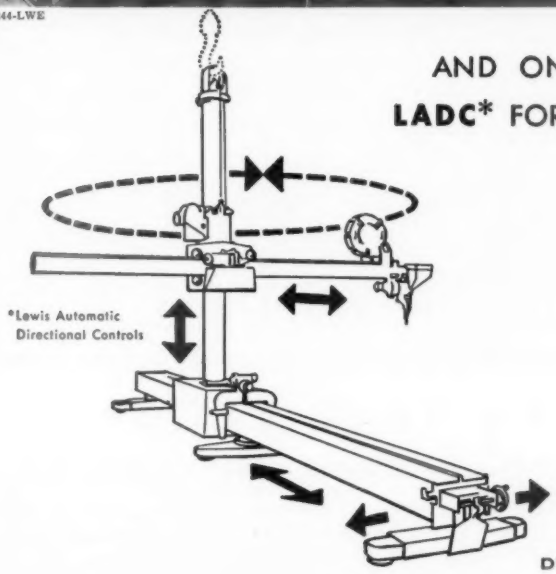


Welding and brazing build engines for Air Force's Titan

SACRAMENTO, CALIFORNIA: Powerful engines for the Air Force's Titan are under production at Aerojet-General Corporation's Liquid Rocket Plant here. An Aerojet technician is tungsten arc welding the throat area of a Titan thrust chamber (left). The tapered stainless steel tubes used to make the chamber are positioned on a form and are joined by welding and silver brazing, (right) to produce a lightweight missile component capable of withstanding tremendous heat.

Aerojet designed, developed and is manufacturing the propulsion system for this two-stage second generation ICBM.

8444-LWE



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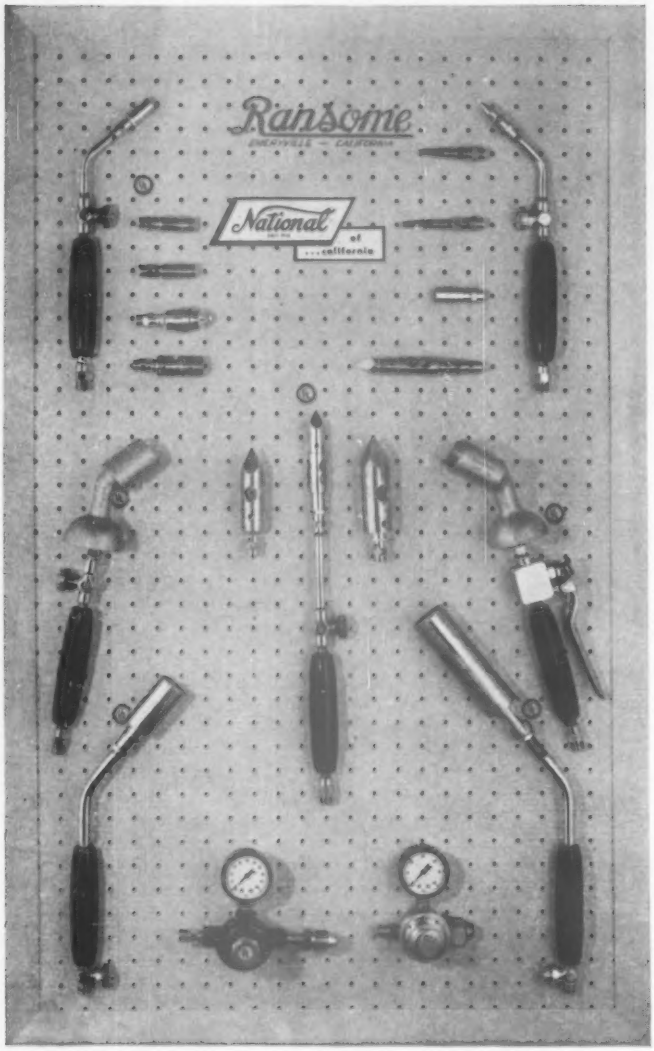

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You will find these two lines both the very best money can buy and the most complete on the market.

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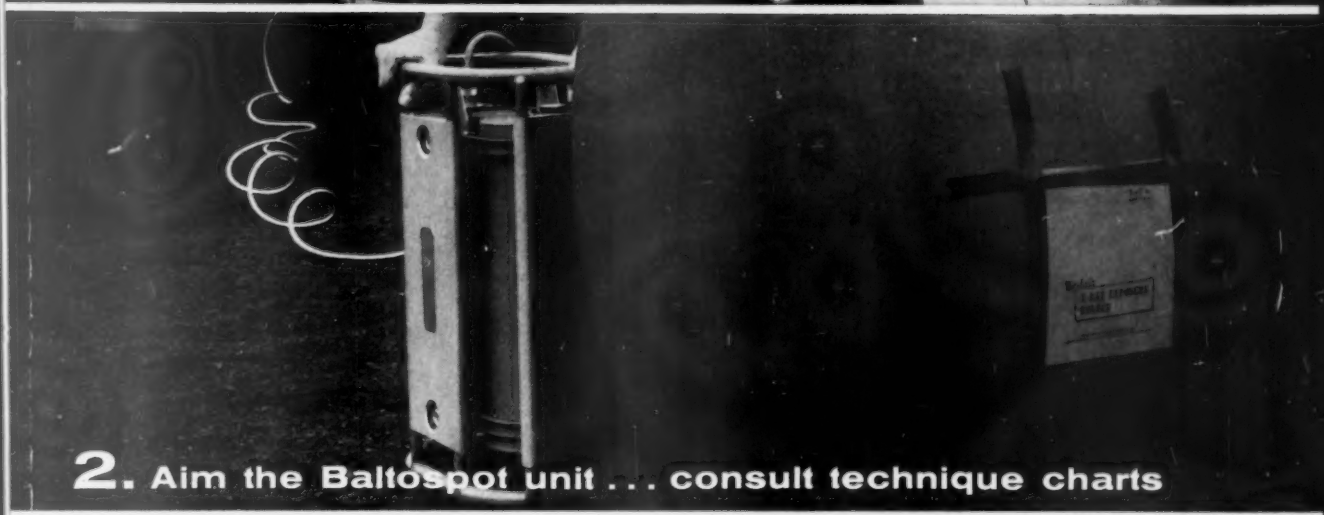

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WELDING MANAGEMENT

watches these developments

A NEW PLAN JUST ANNOUNCED makes it possible for welding equipment manufacturers to set up full programs for installment sales of their income-producing equipment, obtain complete financing and have the financing company handle all customer credit, collection and paper work at no extra charge. The plan was announced by Standard Financial Corp., New York City.

Equipment purchasers would be required to make only a down payment of 15 percent in cash or trade, the balance payable in 1-5 years. Standard Financial will advance to the manufacturer 90 to 100 percent of the gross amount of the customer's installment note, minus the minimal finance charge.

THE BUDD COMPANY OF PHILADELPHIA has been awarded a contract by the Utah Division of Thiokol Chemical Corp. for construction of solid propellant rocket engine cases for the Minuteman Intercontinental Ballistic Missile. Minuteman is the United States Air Force's solid fuel ICBM now under development.

Budd engineers said they have developed a special method of rocket engine case fabrication which will allow use of a new type high alloy steel, AM-355, in carrying out Thiokol's design.

Use of the new alloy steel through efficient methods of resistance and fusion welding is expected to impart to the finished structure the high strength-to-weight ratio essential in missile construction.

THE FACT that the thickest clad material rolled is around 2½-inches has imposed real limitations on designers and fabricators who need clad material two and three times as thick is pointed out by H. E. Snyder, director of marketing, Arcos Corp., Philadelphia. "The development of bonded fluxes for submerged arc welding of stainless and low alloy steels during the past three or four years has opened up new, low cost fabricating techniques for chemical processing and nuclear equipment fabrication," says Mr. Snyder.

"Particular attention is being given to the overlaying of mild steel with Monel and Inconel by submerged arc welding."

"Close control of all materials—core wire and flux ingredients—as well as the amount of dilution of the weld metal by the base material is our immediate goal. Once consistent results are achieved in these areas, cladding of any thickness of mild steel, for example, by submerged arc will result in considerable savings in fabrication as well as adding years to the operating life of equipment so clad."

OLD DOMINION IRON & STEEL CORPORATION of Richmond, Virginia, is embarking on an extensive program of selling the importance of X-ray inspection for non-destructive testing of welds of tanks they fabricate. Storage tanks and pressure vessels are marked "ODIS Registered . . . X-ray Inspected" by the company and are shipped with a certificate of weld soundness and actual X-ray films of the welds. (ODIS are the initial letters of the corporation's name.)

A HIGHLIGHT OF THE QUARTERLY MEETING of the Arc Welding Section of the National Electrical Manufacturers Association held recently was a report on the work of the Federal and Military Specifications Committee. The committee has been working in conjunction with a similar group of the U.S. Navy over the past two years to develop general specifications to be used by the U. S. Government when issuing bids for welding material. It is felt that the general agreement reached between these two committees will be beneficial to the government and to the welding industry as suppliers to the government.

THE USSR WILL STEP UP PRODUCTION OF OXYGEN to several times the 1958 output, according to a review of the 1959-1965 aims in industrial chemistry appearing in the periodical Kislorod. Large quantities will go into a "new, very promising process, the oxidative cracking of natural gas to produce acetylene." Another Russian technical journal, Promyshlenno-Ekonomicheskaya Gazeta, described in some detail the process for "electric cracking of methane" to produce acetylene and predicts it will save "hundreds of millions of rubles."

HARRIS

universal pressure welding torch No. 43 and the No. 49 cutting attachment will

outstanding features:

1. All welding assemblies and cutting attachments operate on *less than 1 pound* of Acetylene, permitting complete withdrawal of all the gas.
2. Safer . . . virtually impossible to back oxygen into acetylene line.
3. Exceptional Flame Stability, due to unique mixing principal.

MAKE US PROVE THESE STATEMENTS

Call your nearest Harris Distributor for a Demonstration—or write to us.

HARRIS CALORIFIC CO.

5501 CASS AVE. • CLEVELAND 2, OHIO

For More Information Circle No. 28 on Reader Service Card.

NEW

Welders' Clothing

AO Light Weight Welders' Clothing for Gas Shielded Electric Welding

Here's real comfort! It's American Optical's new line of light weight leather garments for welders working on *gas shielded electric welding operations* where Argon, Helium and similar gases are used.

Garments are made of a special, soft leather which is not only light and flexible but offers excellent protection from harmful heat rays.

Available in Short Jacket (C-203), Cape Sleeve (C-208), Cape Sleeve and Bib (C-208B), 26″ Jacket (C-206) and Sleeves (C-23). Cape Sleeve and Bib is illustrated. Your nearest American Optical Safety Products Representative can supply you.

Weighs only 15½ ounces! Yes, this cape sleeve offers welders a minimum of weight — a maximum of comfort.

CAPE SLEEVE AND BIB C-208B

Protects arms, chest, shoulders. All seams cotton stitched. Seam ends reinforced with steel rivets. Bib attached to front of cape with snap fasteners. Anchor button at each armpit prevents cape from unbuttoning. Five sizes.

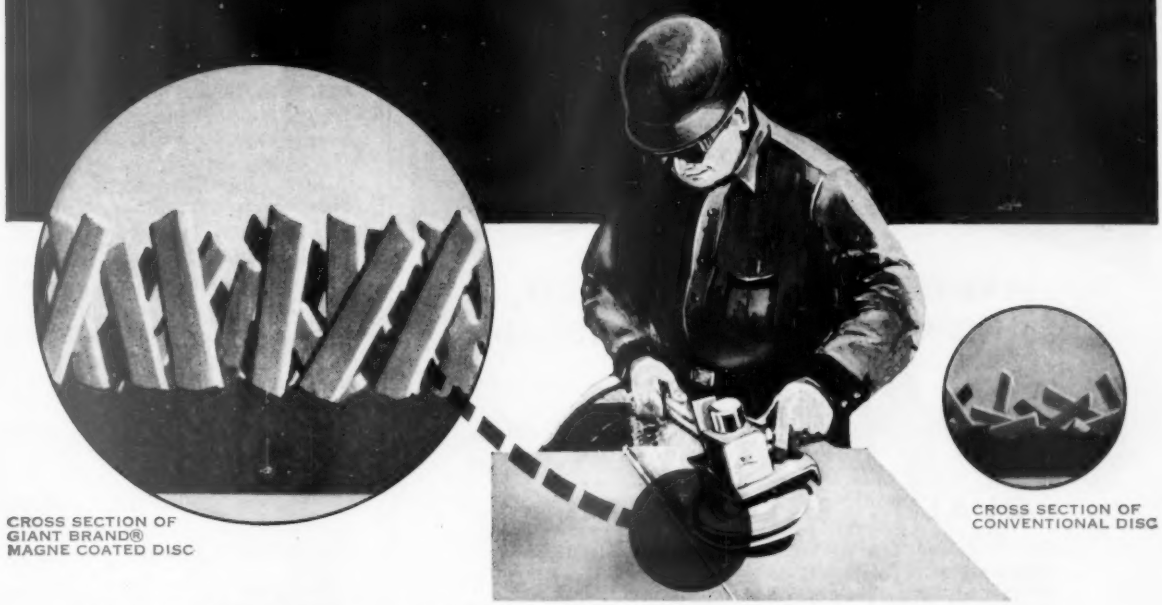
American Optical
COMPANY
SAFETY PRODUCTS DIVISION
SOUTHBRIDGE, MASSACHUSETTS
Safety Service Centers in Principal Cities

Quality costs no more!
Always insist on
Trademarked Safety Products

For More Information Circle No. 9 on Reader Service Card.

Now! revolutionary longer lasting coated abrasive discs give

150% more biting edges



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GIANT BRAND®
MAGNE COATED DISC

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CONVENTIONAL DISC

PATENTED MAGNECOATING* IS THE BIG DIFFERENCE - - - WORKS FASTER, LONGER AND MORE ECONOMICALLY!

*Patented Process — U. S. Pat. 2857 879 issued October 28, 1958 for magnetically orienting abrasive particles.

The big difference in abrasive discs is their **bite.** Through Magnecoating magnetized particles are aligned in a vertical position on a precut sturdy fiber disc. The difference in vertical alignment is more particles to the square inch and constantly renewed **biting edges** as the tops of the particles break off.

The Difference:

- **150% MORE CUTTING EDGES**
- **200% LONGER LIFE**
- **2 TO 4 TIMES GREATER PARTICLE DENSITY**
- **ELIMINATION OF EDGE LOSS**

A complete line of Giant Brand® discs is available for standard, general industrial, sheet metal, soft or semi-soft metals, ceramics, glass, wood and other special applications. **Write today for complete details and sample of Giant Brand® coated abrasive disc.**

GIANT BRAND®

abrasive company of america

492 MAIN STREET, FORT LEE, NEW JERSEY

Warehouses — Fort Lee, N. J. — Omaha, Nebraska — Detroit, Mich. — Los Angeles, Calif. — Jobbers located in all principle cities. Jobbers — some authorized territories still open, write immediately.

For More Information Circle No. 7 on Reader Service Card.

Job report courtesy of
Midwest Piping Co., Inc., St. Louis, Mo.

When stainless welds must pass the most rigid tests possible

USE ARCOS QUALITY FILLER METALS

This 16" diameter Type 304 stainless elbow is part of the reactor cooling system in an atomic powered ship. In welding the two halves, the first pass was made with Arcos Chromend K (Type 308) electrodes. The balance of the joint was submerged arc welded with Arcosite Bonded Flux and Chromenar K (Type 308) wire. The inset shows results of a dramatic test of the Arcos weld metal so produced. A 2½" ring, cut from an elbow, was given the normal bend test—and then completely flattened—without a crack! Such performance is the reason why Arcos is preferred for all tough jobs. ARCOS CORPORATION, 1500 South 50th Street, Philadelphia 43, Pa.

Arcos Chromend K
(Stainless) Electrodes

Arcos Chromenar K Bare Wire
and Arcosite Bonded Flux

For More Information Circle No. 11 on Reader Service Card.

Men On The Move

Hilton

Westerson

PROMOTIONS:

B. R. McBath has been named general manager of *Worthington Corporation's Plainfield Division* which manufactures truck mixers, road pavers and a complete line of welding positioning equipment.

The appointment of **Carl S. Newmarch** as manager of the Philadelphia Branch of *Whitehead Metals, Inc.*, has been announced. In other appointments, **J. I. Doherty** becomes manager of the Cambridge, Mass., Branch and **C. C. McCarthy,** manager of the Windsor, Conn., Branch.

L. S. Hilton has been named manager of the *Abrasive and Diamond Wheel Departments* of the *Manhattan Rubber Division of Raybestos-Manhattan, Inc.*, Passaic, New Jersey.

Promotion of **C. G. Westerson** to southeastern district manager for *Smith Welding Equipment Corp.* has been announced. He will headquarter in Ferguson, Missouri.

L. A. Hamilton is new vice president in charge of *Air Reduction Pacific's* San Francisco district. He succeeds **H. W. Saunders,** retired.

Warren G. Gumm has been named Manager Engineering — Railroad Department, *Linde Company, Division of Union Carbide Corp.* He will be located in Chicago.

ADDRESS CHANGES:

R. K. Innes, manager of cylinder sales, Eastern Area, for *Nor-*

ris-Thermador Corporation, has moved his offices to 248 Lorraine Ave., Upper Montclair, N. J. Telephone is PIlgrim 6-6884.

APPOINTMENTS:

Compressed Gases of Ohio, Inc., is a new unit of *Air Products, Inc.,* and will distribute and market industrial and medical gases in the Cleveland marketing area. A complete line of welding and cutting equipment and supplies will continue to be distributed. **R. William Metzger,** formerly president of *Compressed Gases of Ohio, Inc.,* will head the operation as district manager.

Appointment of **Dr. R. M. Kary** as a member of the research staff, *Metal & Thermit Corp.,* has been announced.

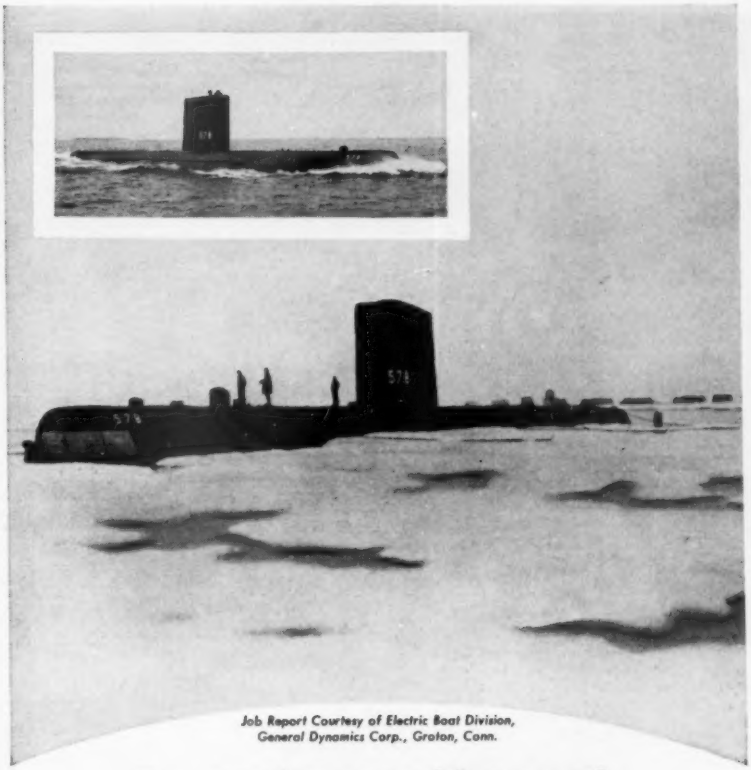
ELECTIONS:

Gilman

Randall

Arthur E. Gilman was elected president of *Bay State Abrasive Products Co.,* Westboro, Mass., at a recent meeting of the Board of Directors. Mr. Gilman was elected treasurer of Bay State in May, 1956, and will retain this position along with the presidency. He is the third president since the company was founded in 1922.

Frank Randall has been elected vice president of *North American Philips Co., Inc.* Mr. Randall will retain his position as president of *Amperex Electronic Corp.,* an affiliate of N. A. Philips.



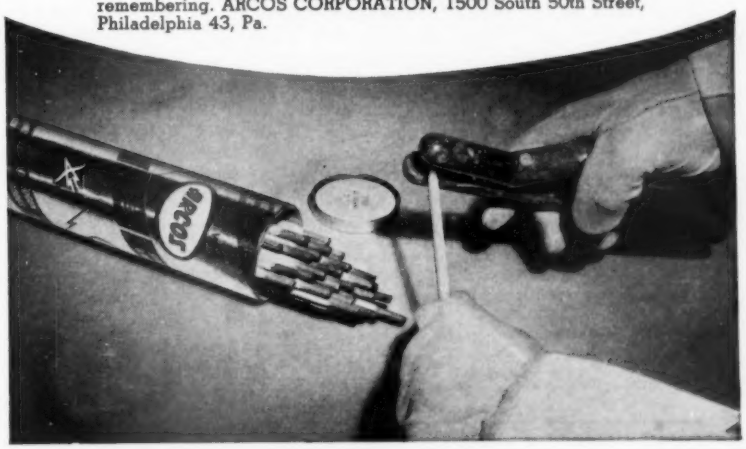
Job Report Courtesy of Electric Boat Division, General Dynamics Corp., Groton, Conn.

For maximum weld strength at sub-zero temperatures

WELD WITH ARCOS

LOW ALLOY ELECTRODES

The Skate (above), as well as the Nautilus, Seawolf, Swordfish, Skipjack and Triton are among the "greats" in America's atomic powered sub force carrying welds produced by ARCOS low alloy electrodes. ARCOS Tensilend 80, 100, 120 and Ductilend were used to assure welds of highest possible impact strength whether on missions in the tropics or the sub-zero arctic. When you need weld metals with similar qualities, ARCOS is well worth remembering. ARCOS CORPORATION, 1500 South 50th Street, Philadelphia 43, Pa.



For More Information Circle No. 12 on Reader Service Card.

Introducing the NEW MODEL 1-A SEVER-ALL Machine... CUTS AT 3 to 6 SECONDS PER SQUARE INCH—ECONOMICALLY

MANY EXTRA FEATURES AT A DELIVERED COST UNDER $500

You get the cut quality and capacity of machines nearly three times as expensive when you use the new Model 1-A SEVER-ALL oscillating dry abrasive cut-off machine. Available from your distributor's stock. Here's why the #1-A SEVER-ALL is ideal for industrial and machine shop operations:

BIG CAPACITY • Up to 2″ square solids, 3½″ O. D. pipe and tubing, 3″ angle iron, and 4″ channels . . . of cold rolled, stainless, and alloyed steel; cast iron; and nonferrous metals. Wheel oscillation, an exclusive feature in this price range, provides this *above-average* capacity.

SPEED • Cuts a 2″ x 2″ hardened steel bar in 16 seconds . . . other shapes and sizes at 3 to 6 seconds per square inch.

QUALITY • Clean, smooth cuts, even on large sections, because wheel oscillation provides cooler cutting.

ECONOMY • In addition to low initial cost, the Model 1-A SEVER-ALL is inexpensive to operate . . . occupies minimum floor space . . . requires little or no set-up time . . . eliminates annealing costs . . . gives more cuts per wheel because of oscillation.

SIMPLICITY • Just two SEVER-ALL cutting wheel specifications will do *all* your SEVER-ALL cutting jobs. A positive, screw-type vise holds all regular shapes, and an adjustable work stop provides speed and accuracy.

ANGLE CUTS • Optional accessory permits cutting angles up to 45° in either direction.

NEW SEVER-ALL AVAILABLE FROM DISTRIBUTORS

Very likely your own distributor already stocks the Model 1-A SEVER-ALL machine and wheels. If not, let us know, and we'll give you the name of your nearest SEVER-ALL distributor. Also, we'll be glad to send you complete details on this new machine. Just ask for **Bulletin DH-106.**

ALLISON-CAMPBELL DIVISION
AMERICAN CHAIN & CABLE

ACCO

925 Connecticut Avenue, Bridgeport 2, Conn.

For More Information Circle No. 5 on Reader Service Card.

brazed successfully with

SILVALOY

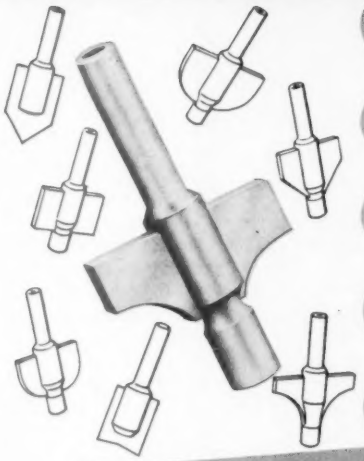
LOW TEMPERATURE SILVER BRAZING ALLOY

Millers Falls Router Bits and Dyno-Mite high-speed power bits are revolutionary in concept, design and materials. They both perform with such unmatched efficiency that they have reached the "top-of-the-list" in their field.

Dependable, prolonged service is a "must" for all Millers Falls products and the component parts of both bits are therefore brazed with Silvaloy. The joints are as strong as the high-speed steels they join. Millers Falls uses Silvaloy 45 and Deoxo flux for these operations.

Silvaloy Brazing Alloys and APW Fluxes are helping to speed production, lower costs and improve brazing results in many fields. Call your nearest Silvaloy Distributor for information or technical assistance. ★

The Millers Falls Company is a leading manufacturer of quality hand and power tools for home and industry for over 90 years.



MILLERS FALLS TOOLS
SINCE 1868

AMERICAN PLATINUM & SILVER DIVISION

ENGELHARD INDUSTRIES, INC.

EXECUTIVE OFFICES:

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THE SILVALOY DISTRIBUTORS

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CLEVELAND, OHIO

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LICENSED CANADIAN MANUFACTURER
ENGELHARD INDUSTRIES OF CANADA, LTD. • TORONTO • MONTREAL

Two complete reference manuals for low-temperature silver brazing and fluxing are available upon request. Send for either one or both. ★ ★ ★ ★ ★ ★ ★

For More Information Circle No. 10 on Reader Service Card.

How Claude Phillips helped

More than ten years experience as a welding specialist gave Claude Phillips a sound basic knowledge of metallurgy and grinding methods. In the years since World War II, he has expanded that knowledge into an expert's familiarity with all types of grinding techniques. It is this wide yet concentrated experience that makes him so outstandingly useful to his customers.

For More Information Circle No. 15 on Reader Service Card.

cut stainless steel weld-grinding costs

There's nothing delicate about stainless steel until you overheat it. Then you've got a problem... because excessive heat breaks down the chemical structure of the metal and reduces its resistance to corrosion.

Nobody is more conscious of this than Plant Manager John Luker of Gaston County Dyeing Machine Co., Stanley, N. C., and the man who helped him solve the problem . . . Claude Phillips of Bay State distributor Southern Oxygen Company.

Knowing the job that Bay State Blue Flash R grade wheels had been doing for others, Phillips persuaded Luker and Purchasing Agent James Stroup to try them. They not only cut cool... comfortably below the 670°F critical limit of stainless... they gave him a higher rate of stock removal than any other wheel on the market. As a result, more work is produced per payroll dollar and there are neither hot spots nor weak spots in Gaston County Dyeing machines.

Like Claude Phillips, your own Bay State distributor is an experienced specialist in grinding problems. Cost-cutting ideas he develops for others may be unexpectedly useful to you, too. Why not get in touch with him and see what he can do? *Better grinding at lower cost—that is his business.*

Operator uses 9" x 1/8" Blue Flash R grade raised hub disc wheel to blend pressure tank of T-316 stainless. This wheel generates minimum heat yet gives extremely high rate of stock removal.

BAY STATE WHEELS of PROGRESS

BAY STATE ABRASIVES

Bay State Abrasive Products Co., Westboro, Massachusetts.
In Canada: Bay State Abrasive Products Co., (Canada) Ltd., Brantford, Ontario.
Branch Offices: Bristol, Conn., Chicago, Cleveland, Detroit, Pittsburgh. *Distributors:* All principal cities.

For More Information Circle No. 15 on Reader Service Card.

VICTOR CUTTING TORCHES AND TIPS

. . . because he can always count on Victor to fill his needs. Shown here is one of Victor's **new** LPCG series . . . available for both hand and machine cutting with **new** natural and propane preheat gas cutting tips.

Remember, Victor torches perform best when you use genuine Victor cutting tips. Order from your Victor dealer now and cut your costs with Victor cutting tips.

VICTOR for welding

VICTOR EQUIPMENT COMPANY

Mfrs. of welding & cutting equipment; high pressure and large volume gas regulators; hardfacing rods, blasting nozzles; cobalt & tungsten castings; straightline and shape cutting machines.

844 Folsom St., San Francisco 7 • 3821 Santa Fe Avenue, Los Angeles 58
1145 E. 76th St., Chicago 19
J. C. Menzies & Co., Wholly-Owned Subsidiary

48

For More Information Circle No. 56 on Reader Service Card.

LIBRARY

of welding

FABRICATION OF MOLYBDENUM

"Fabrication of Molybdenum" is published by American Society for Metals, 7301 Euclid Avenue, Cleveland 3, Ohio; 221 pages; $6.50.

Much previously classified material appears in print for the first time in this new book published by the American Society for Metals. It contains 18 papers presented at an ASM conference in May, 1958. The book is offered in paper bound, 8½- by 11-inch format. Charts, graphs, photos and photomicrographs appear throughout the book's 221 pages.

Techniques covered in the new volume include forming, welding, protection and coating. Fabrication of molybdenum is covered thoroughly.

1958 BOOK OF ASTM STANDARDS

"1958 Book of ASTM Standards" is published in 10 parts by the American Society for Testing Materials, 1916 Race Street, Philadelphia 3, Penna.; 13,600 pages; $116.00 for complete set.

The 10 parts include 2,450 standard specifications, methods of test, definition of terms and recommended practices.

Each of these parts is complete with a detailed subject index and a list of standards in numeric sequence. The three parts of greatest interest to welding and metalworking people are:

Part 1. Ferrous Metals Specifications (Except Test Methods), 1620 pp, 291 standards, $12.00.

Part 2. Non-Ferrous Metals Specifications (Except Test Methods), Electronic Materials, 1380 pp, 251 standards, $10.00.

Part 3. Metals Test Methods (Except Chemical Analysis), 992 pp, 121 standards, $10.00.

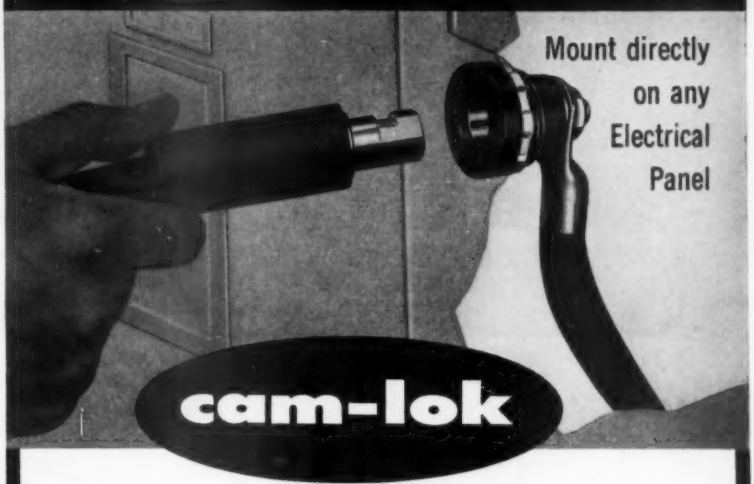
The complete set is priced at $116.00.

SPOT WELDING INCONEL "X"

Bulletin No. 26 (Spot Welding of Inconel 'X' in Thickness Range of .032" to .188"), Resistance Welder Manufacturers' Association, 1900 Arch Street, Philadelphia 3, Penna., $.20 each.

The latest bulletin of the Resistance Welder Manufacturers' Association covers the properties of Inconel "X"; welding with Tri-phase DC machines; welding with single phase AC machines; postweld heat and forging pressure; X-ray examination and spot weld macrographic examination.

New Hi-Impact Plastic Insulated
Panel Receptacles and Mating Plugs



Now, you can make fast, positive power connections to any metal panel or housing without special insulating materials. Simply punch out a hole and insert a Cam-Lok self-insulated Receptacle! Uses standard electrical lock-nuts, affords "dead-front" protection. Push in and twist Cam-Lok mating Plug and you've made a locked connection, which can be released quickly.

New Cam-Lok Receptacles eliminate costs of special insulating panels and reduce assembly time. Patented, high-pressure contact assures minimum resistance and heating.

Cam-Lok has a complete line of Receptacles and Plugs in many sizes and designs. Standard and special purpose Power Distribution Connections are available. Write today for new Bulletin No. 301.

"Dead Front" design for fast
direct mounting on . . .

• ELECTRICAL DISTRIBUTION PANELS • SWITCHGEAR
• BUS DUCT • JUNCTION BOXES
• WIREWAY or any electrical cubicle

A Complete Line of Welding Accessories and Special Power Distribution Connections

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CINCINNATI 36, OHIO

For More Information Circle No. 17 on Reader Service Card.

Dick Deily announces sales and service headquarters for the remarkable . . .

MESSER
CUTTING MACHINES

For the most advanced techniques in oxygen cutting and automated cutting equipment, consult the representative nearest you.

CALIFORNIA
- Los Angeles
  - **Burdett Oxygen Company**
- San Francisco
  - **Victor Equipment Company**

DISTRICT OF COLUMBIA
- **Southern Oxygen Company**

GEORGIA
- **Southern Oxygen Company**

ILLINOIS
- **General Dynamics Corporation**
  Liquid Carbonic Division

INDIANA
- **General Dynamics Corporation**
  Liquid Carbonic Division

KENTUCKY
- **General Dynamics Corporation**
  Liquid Carbonic Division

LOUISIANA
- **General Dynamics Corporation**
  Liquid Carbonic Division

MARYLAND
- **Southern Oxygen Company**

MASSACHUSETTS
- **Charles Peirce Associates**

MICHIGAN
- **General Dynamics Corporation**
  Liquid Carbonic Division

MINNESOTA
- **C R O Engineering Company**

MISSOURI
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NEW YORK
- Buffalo
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OHIO
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- Philadelphia
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- **Southern Oxygen Company**

TEXAS
- Fort Worth
  - **Big Three Welding Supply Company**
- Houston
  - **Big Three Welding Equipment Co.**

VIRGINIA
- **Southern Oxygen Company**

WASHINGTON
- **Industrial Air Products Company**

WISCONSIN
- **C R O Engineering Company**

REGIONAL REPRESENTATIVES

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  New York, N.Y.

CENTRAL
- **R. W. Kleine**
  Milwaukee, Wisconsin

SOUTHERN
- **Paul M. W. Bruckmann**
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- **W. S. Johnson**
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WELDING ENGINEERING · Messer · SINCE 1898

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CHRYSLER BUILDING · 405 LEXINGTON AVENUE · NEW YORK, N.Y.

For More Information Circle No. 37 on Reader Service Card.

INDUSTRY **NEWS**

PRESIDENT-ELECT AXTELL (left) succeeds Leslie P. Beaver, Jr. (right).

THESE OFFICERS will guide the National Welding Supply Association during 1959-1960.

Election Of Officers Highlights N.W.S.A. Convention

SAN FRANCISCO, CALIFORNIA: A 4-point improvement program has been announced by President-elect A. C. Axtell who took office during the National Welding Supply Association's 15th annual convention held here in May. Axtell, who is president of Essex Welding Equipment Co., Newark, said he would try to (1) increase N.W.S.A. membership by at least 100 over present mark of 580, (2) increase industry recognition and acceptance of the N.W.S.A., (3) initiate marketing studies to help distributors do a better job and (4) improve and increase the efficiency of the Association's already successful Contact Booth Program.

President Axtell will get able assistance from an Executive Vice President. Named to fill this newly-created position as administrative assistant to the president and membership chairman was V. B. Anderson, of V. B. Anderson, Co., Santa Ana, Calif.

Six Zone Vice Presidents were elected. They are T. Barrett Quinn, Harvey Company of Greensburg (Pa.), Inc.; Reid Jones, Jr., Jones Welding Supplies, Roanoke; W. T. Hart, Valley Welding Supply Inc., Appleton, Wis.; H. R. Toll, H. R. Toll Company, Minneapolis; Jack MacWhorter, Southwestern Welding Supply Co., San Angelo, Texas; and Thomas B. Middleton, Middleton Welders Supply Co., San Leandro, Calif.

New Directors taking office were Harry C. Baker, Baker Welding Supply, Cincinnati; Orrin C. Smith, Missouri Oxygen Co., Macon, Mo.; Ted Cox, Ted Cox, Welding Supplies, San Bernardino; Don C. Berner, Welders Supply Co., Philadelphia, and Bruno H. Klemmer, Welders Supply Co., Chicago.

President Leslie P. Beaver, Jr., Beaver Welding Supplies Co., Memphis, opened the Convention's first business session with a "Let's Talk" address.

The Keynote Speaker, Lawrence C. Lockley, Dean of the School of Commerce, University of Southern California, delivered an interesting and informative talk on marketing.

William L. Young, Convair Astronautics Division of General Dynamics Corp. spoke on the part welding plays in our nation's missile program.

The second business session was highlighted by Vern K. Miller, H. K. Miller, Inc., Chicago, who discussed "Creative Selling of Arc Welding Machines." A panel discussion followed on "Lowering Costs Through Increased Efficiency." The panel was moderated by President Beaver and consisted of H. R. McGarvey, Gilbert Schnitzer, T. Barrett Quinn and J. K. Calhoun. Following talks by panel members on office procedures, warehousing, trucking and sales, a discussion was held.

The Association's 10th annual Contact Booth Program was one of the most successful ever held. Some 79 manufacturers participated and distributor attendance was at an all time high.

In all, 552 persons attended the convention: 205 distributors, 170 manufacturers, 165 ladies and 12 guests.

205 DISTRIBUTORS attended the NWSA's 15th annual convention.

Death Takes J. C. Lincoln And A. F. Davis

J. C. Lincoln

A. F. (Charlie) Davis

THE WELDING INDUSTRY is mourning the passing of John Cromwell Lincoln, founder of the Lincoln Electric Company, and Alton Frank (Charlie) Davis, Lincoln vice president and secretary.

Mr. Lincoln died at 92 in Scottsdale, near Phoenix, Arizona.

Mr. Davis died at 69 in Cleveland, Ohio, after an extended illness.

Coincidentally, each died within a few hours of the other, on Monday, May 25th.

John C. Lincoln

Reportedly a fabulously wealthy man with an estate estimated at 50 to 100 million dollars, Mr. Lincoln had large real estate holdings in Cleveland and Columbus, Ohio, and Miami Beach, Florida. In Arizona, where he moved about 25 years ago, he maintained active direction of the Bagdad Copper Co. and the Camelback Inn.

Mr. Lincoln was president of his company until 1928 when he became board chairman and turned operations over to his younger brother, James F. Lincoln.

Mr. Lincoln attended Ohio State University where he took all electrical courses that were then offered. He graduated in 1888.

Mr. Lincoln worked for several electrical manufacturers before forming the Lincoln Electric Co. in 1893. The first shop had a floor area of 30 by 100 feet and a cash investment of $250. The company, which made one- and two-horsepower electric motors, grew steadily and moved to larger quarters several times before 1906, when it was incorporated with a capital of $10,000.

Mr. Lincoln was president of the company from 1906 to 1928, when he became chairman of the board and was succeeded by his brother.

The welding machine part of the business increased rapidly; it is principally for such equipment that the company is known today.

Mr. Lincoln developed many of the company's products himself and was issued more than 50 patents for electrical devices, among them the variable speed motor. He was a pioneer in the development of ductile welds.

Unusual was Mr. Lincoln's interest in the economic theories of single-taxer Henry George. An ardent champion of the single

continued on page 50

Harris Calorific Distributors Meet In Cleveland

CLEVELAND, OHIO: Harris Calorific Company's domestic business for the first four months of this year was 68 percent greater than for the same period in 1958, C. M. Taylor, president, told a recent meeting of Harris' distributors held in Cleveland, Ohio. Distributors also heard Leigh Perkins, vice president in charge of sales, point out that the first half of May was 100 percent ahead of the same period in 1958.

Other meeting activities included discussions of sales techniques and marketing and merchandising problems, demonstrations of new and improved products and a tour of the Harris factory and factory laboratory.

Wear-O-Matic Hard Surfacing is 3 Ways Better

1 *Faster . . . More Economical*

The Wear-O-Matic process of semi-automatic hard surfacing is continuous welding with manual control of the arc. However, unlike manual welding with stick electrodes, there is no time consuming slag cleaning or electrode changes. Higher deposition rates, 3 to 5 times faster than stick electrodes, greater deposition efficiency, 85 to 95%, plus more available arc time add up to savings of 40 to 50% over manual hard surfacing with stick electrodes.

2 *Uniform Resistance to Wear*

The superior wear resistance qualities of Wear-O-Matic hard surfacing wires is the result of closely controlled manufacture, properly balanced alloys and fluxing agents, and precision drawing. Wear-O-Matic 7/64″ diameter open arc wires are precision drawn to true wire diameter ± 0.002″ and through drawing are densely compacted assuring an easier feeding wire that will not crush in the feed rolls or bind in the feed cable. Dense compaction and closely controlled fabrication combine to provide a weld deposit more uniform in chemistry and metallurgy resulting in uniform hardness and greater wear resistance throughout the deposit.

3 *Greater Efficiency and Ease of Application*

Here's a hard surfacing combination *designed* to cut maintenance cost through the *profitable* utilization of your welder's time. Wear-O-Matic wires in WELD-PAKS are the key to greater efficiency of both semi-automatic equipment and operator. Each WELD-PAK contains 100 pounds of wire packaged in a "dead cast" resulting in tension free, snarl free feeding. Because the WELD-PAK contains 2 to 4 times more wire than standard coils, the amount of time spent handling wire is lessened, providing more time for welding. WELD-PAKS are easier to handle and store; and on the job, the lid can be replaced after use assuring dirt and dust free wire when you are ready to resume welding. From set-up to finished job, the Wear-O-Matic process is easier and faster, eliminating overtime or providing more time for other maintenance jobs. Job test this time saving process in your own shop. Request Bulletin HS-101 for complete details. Alloy Rods Company, P. O. Box 1828, York, Pennsylvania.

Wear-O-Matic Wire Feed Unit $279.00 f.o.b. York, Penna. or El Segundo, Calif.

Weld-Pak is the trade name for this exclusive Wear-O-Matic package.

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QUALITY WELDING ELECTRODES FOR

- Stainless Steel
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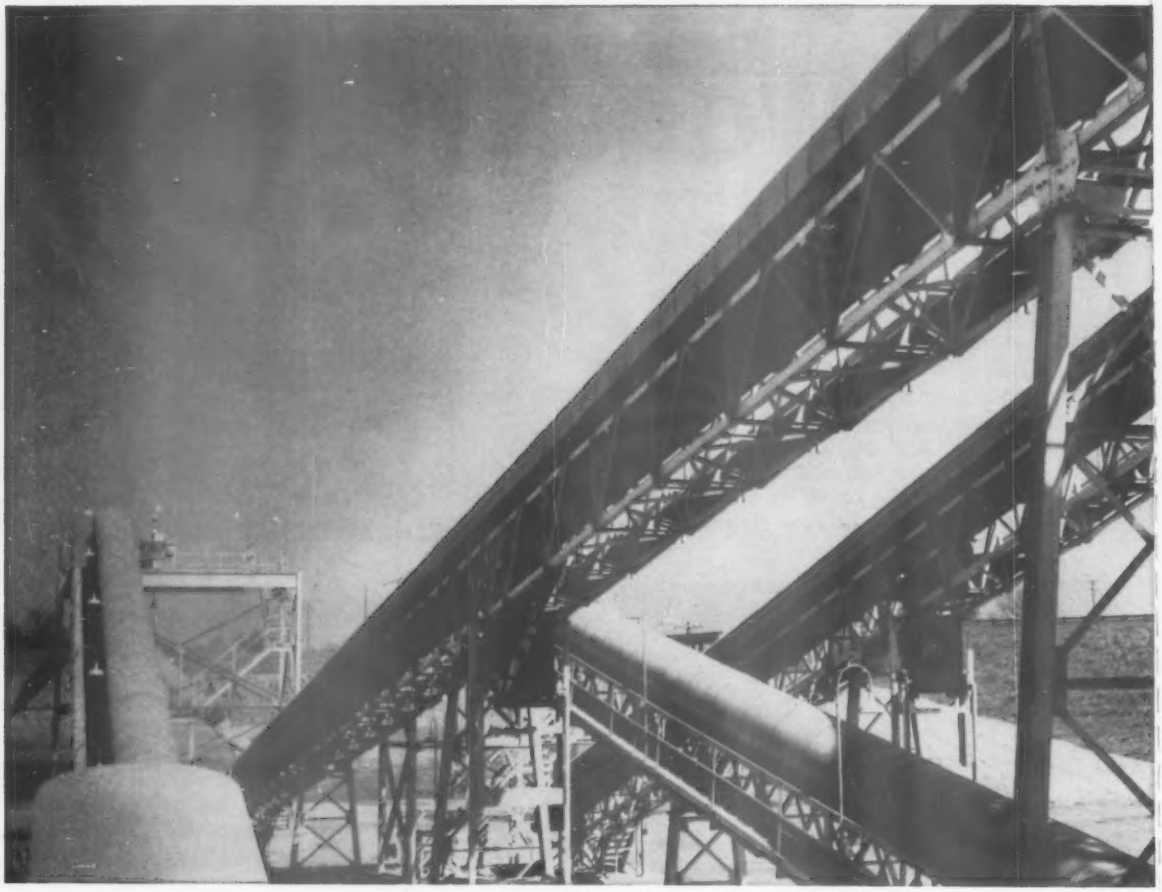

New—from the ground up, Monarch Cement's new Humboldt, Kansas, plant is one of the most modern cement processing plants in the world.

Now we SCHEDULE

"We do our rebuilding when we want to—not when the machine breaks down!

"Both primary and secondary hammermills are repaired and hardsurfaced at the same time at Monarch Cement Company. We do not stop for one repair now and the other later," says Mr. R. M. Vincent, Maintenance Engineer.

"At last we have found a hardsurfacing electrode which gives *predictable* wear. We can plan our hammer service life so both primary and secondary mills are due to be changed at about the same time. No more unscheduled work

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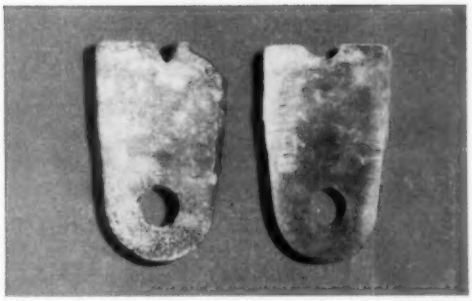
Hammermill hammers are built-up with Lincoln "Faceweld 12" for longer life.

Hammermill repairs!

stoppages because of worn out hammers."

This ability to match the service-life of mill hammers gives great savings in the continuous processing of shale at Monarch Cement Company's new plant at Humboldt, Kansas.

The electrode which makes it possible is Lincoln's "Faceweld 12". Try it on your hammers! Look for your Lincoln District Sales Office or Authorized Dealer in the Yellow Pages.



Before and after photo shows amount of rebuilding necessary on worn hammer.

THE LINCOLN ELECTRIC COMPANY • Dept. 1856, Cleveland 17, Ohio

The World's Largest Manufacturer of Arc Welding Equipment

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VIS-ARC W7-350 Water-Cooled Torch
350 Amp Capacity-only

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A7-150 TORCH—150 AMP
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AIR and WATER COOLED INERT GAS WELDING TORCHES

A new complete line of manual inert arc welding torches covering the entire range of TIG Welding from 50 Amp. air cooled to 500 Amp. water cooled. Vis-Arc torches "dare to be compared" for performance, cool operation, durability and price.

The leakproof torches that give you full gas shielding. Lightweight, comfortable, easy to handle, Vis-Arc torches reduce operator fatigue and increase welding output. Revolutionary new head design eliminates "O" rings. Eliminates leakage and permits greater water cooling—actually 3½ gallons of cooling water per minute!! This means no burn outs, no overheating without weight added to the torch.

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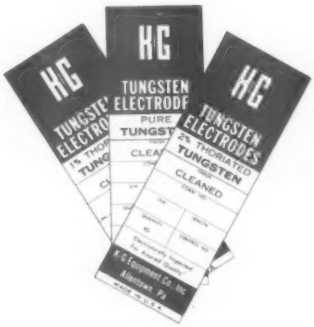
All purpose electrodes for Vis-Arc torches. Each piece "electronically inspected" assuring your satisfaction of the highest quality in tungsten electrodes. Be sure—be safe on every job with K-G Tungsten Electrodes.



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THE K-G EQUIPMENT COMPANY INCORPORATED

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JULY, 1959
WELDING
DESIGN & FABRICATION

After 29 years . . .

INDUSTRY & WELDING Magazine is changing its name

It is not an easy decision to change a fine and highly considered name after 29 years, but progress is inexorable.

In the 29 years of INDUSTRY & WELDING's life the welding process has grown from 30,000 pounds of shielded arc electrodes in the whole year of 1930 to millions of pounds per month now.
Oxygen and acetylene sales have kept apace. Welding equipment, and collateral equipment as well, are used extensively in American industry.

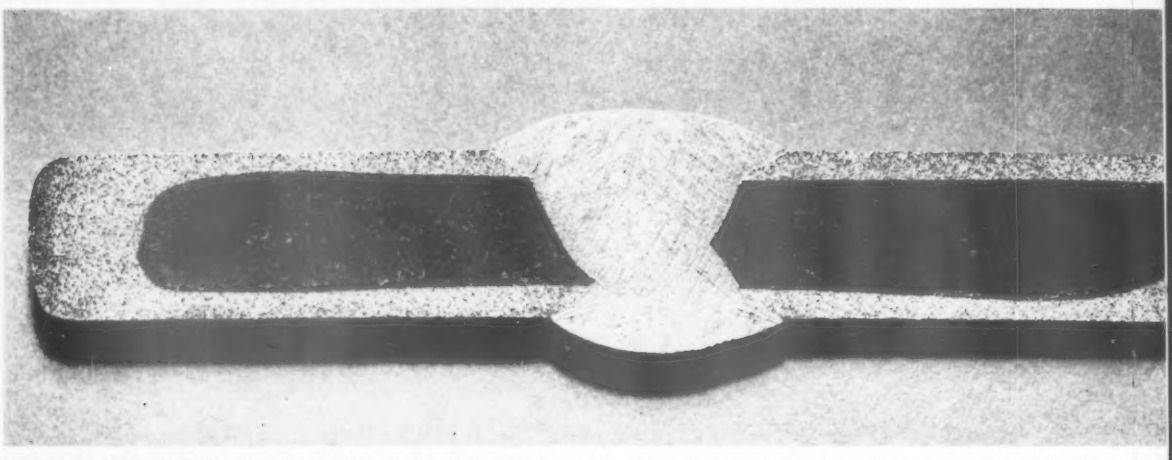
In 1930 our main editorial theme was HOW to weld because we were pioneering in a new industry. That period could be compared to the automobile industry of 1910 when people had to be taught to drive.
Now the editorial emphasis of INDUSTRY & WELDING has broadened to include the designing of weldments and the fabrication thereof.
So it is our considered judgment that a new name will better fit our present editorial approach and permit us to do some new things which fit under the new name better than the old.

Under the new name, WELDING DESIGN & FABRICATION can editorialize the total welding management function . . . welding design, welding methods and the fabrication of weldments. Only through the proper balance and integration of these three interdependent welding functions can the welding industry continue its accelerated growth.

WELDING DESIGN & FABRICATION will dedicate itself to this job.

Tom Dempsey
GENERAL MANAGER

Why must these welds be so much stronger and better



WELD MACROSECTIONS show that weld metal is denser and sounder than parent metals: rimmed steel (above) and killed steel (opposite page).

Unreasonable Codes Discourage

says J. F. Lincoln, *Chairman of the Board, Lincoln Electric Co., Cleveland*

IN BRIEF: Unrealistic standards discourage the use of welding in buildings, bridges and fabrications, hamper the redesign of castings and forgings and prevent billion-dollar savings that could result.

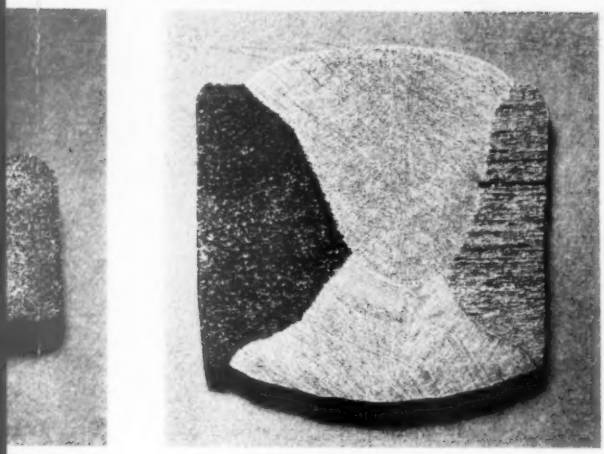
THE PRESENT WELDING STANDARDS have resulted not only in increased cost in examining welds to see that they come up to the written standards, but, more than that, they have created suspicion in the minds of those who are not fully informed on the virtues of welding, which limits its use to a point far below what would be done if welding were understood and therefore accepted as it should be.

It is of course true that any new process is subject to question by those who should use it because of its difference from previous custom. This has been true of every step forward that has been taken in all engineering fields. This is

ABOUT THE AUTHOR: James Finney Lincoln was born in Painesville, Ohio, on May 14, 1883. He attended Ohio State University where he studied electrical engineering. In 1907 he became a sales engineer with the Lincoln Electric Company, which had been founded by his late brother, John, in 1895, for the production of direct current motors. He became vice president of the firm in 1911, general manager in 1914 and president in 1928, the position he maintained until 1954 when he became Chairman of the Board.

Under his leadership, Lincoln Electric Company became the world's largest manufacturer of arc welding equipment. From its shop space of some 50,000 square feet, when Lincoln assumed management control, the company has expanded into a unique, modern plant of almost 30 acres in floor area. The number of employees has increased more than tenfold and the gross dollar business volume is over 700 times as much.

than the base metal?



Welded Design

illustrated by the objection at first to railroads, automobiles and airplanes, to mention a few.

Arc welding has been in commercial use now for a good deal more than a generation. It is accepted as the only commercial way that metals can be joined and have full strength in the joint. It is accepted now by all engineers if full joint strength is required.

It is also accepted commercially without any test in many cases such as automobile frames, weldments and repair of castings and forgings where failure would be far more serious than in the places now tested to the ultimate.

The record that arc welding has made certainly should revise the present standards which have increased the cost of its use enormously. Because of the cost and consequent suspicion of welding that these unnecessary tests produce, the use of welding has been eliminated in many places where it could be of tremendous service. Its application in buildings, bridges and the redesigning of castings and forgings would save many billions of cost that old designs and methods now necessitate.

The present rules, which are limiting the use of welding, make all tests in stress areas where the joint never could be used. They make no tests in the areas where the joint will be used. All welds are tested to the ultimate, which would be at least four times the stresses that actually would be used in production. No riveted or bolted joint could pass any of these tests.

There are specifications in the areas where the weld would be used. In fact, if any structure were subject to the test stresses half as great as those now specified for the welded joint, it would be beyond the elastic limit of the parent metal, which would, if applied, of course scrap the structure.

Another area in which welding is put under very costly investigation is in the matter of porosity. It has been proved by research so that it cannot be doubted that as long as the porosity is not more than 7% of the volume of the weld that there is no change in the strength or ductility of the weld. Such porosity is far beyond what is found in usual commercial welding operations. Porosity within this limit is advantageous. It protects the weld against the possibilities of cracking.

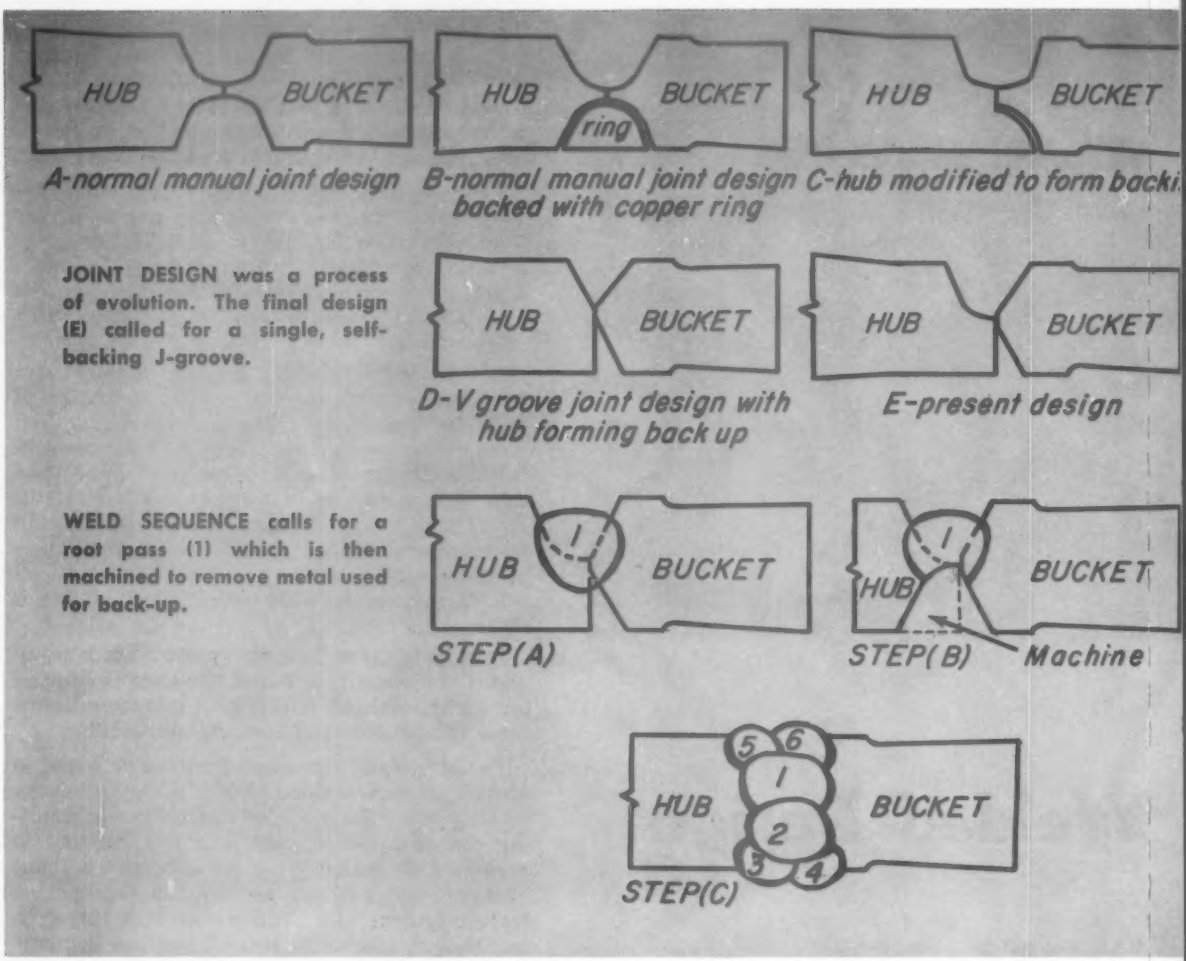
In spite of these facts, many welds are x-rayed and if any porosity is found, the weld is chipped out and re-welded. The cost of this operation is more than the cost of the original welding.

Porosity many times any that can be found in any commercial welded joint is present in every riveted joint. Such porosity and also the resulting concentrated stresses which is inherent in a riveted or bolted joint are accepted without question and without test by the engineering fraternity generally. This is done in spite of the fact that no riveted or bolted joint can be made that is as strong as the plate welded.

A new view should be taken of welding standards. The weld metal which is deposited in a weld is much better than the parent metal that it joins which has been rolled from an ingot that is far from a perfect structure compared to the deposited weld metal. A welded joint of the same dimension and analysis as the parent metal in mild steel is always superior in strength to the parent metal therefore weld metal of the same analysis as the parent metal will always be stronger than the parent metal that it is joining.

Why should not welding, therefore, be accepted without question, as is now done with a riveted or bolted joint which cannot under any condition be of full strength of the parent metal. The economy cannot allow the present waste inherent in our present welding inspection policies to continue to eliminate the savings and the advantages that welding can contribute. • •

EDITOR'S NOTE: We would be glad to get letters from any of our readers who agree—or disagree—with Mr. Lincoln.



Joint Design For Automatic Welding Eliminates Cracking And Porosity

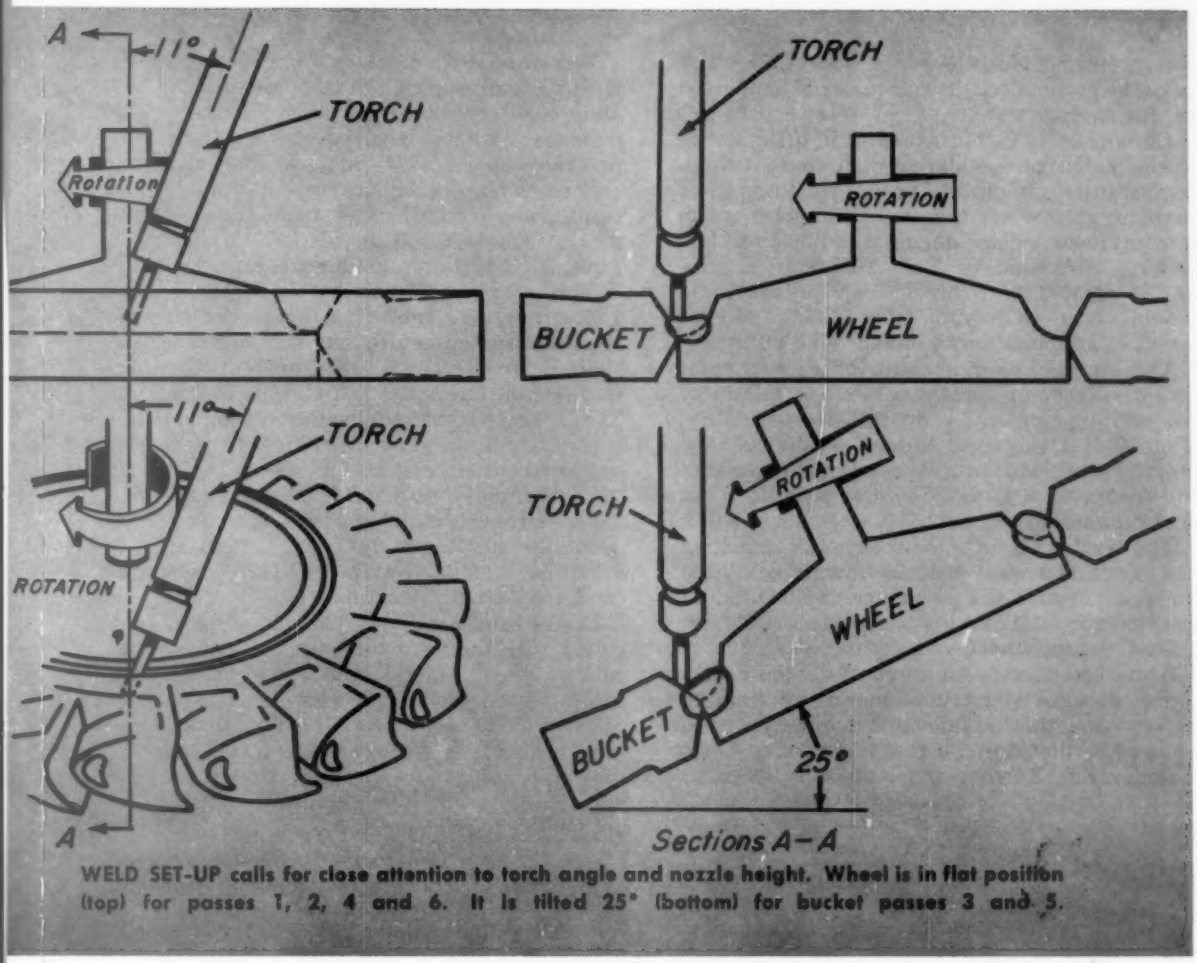
by A. J. ROSENBERG, Manager-Metals Engineering, and E. W. JAMISON, Metals Engineer,
Materials & Processes Lab, Aircraft Accessory Turbine Dept., General Electric Co.

IN BRIEF: Good joint design and correct welding procedures minimize cracking and porosity in consumable electrode welding a low alloy forged steel to a cast high temperature alloy.

ONE OF THE MOST CRITICAL PRODUCTS in industry today is the high speed turbine wheel. Reliability must be coupled with low manufacturing costs. Welding plays an important part in fabricating these wheels since it permits the combination of a variety of materials for optimum properties in the wheel blank, shaft and buckets. For example, the wheel we are discussing here has a low alloy steel forged hub and shaft welded to a cast high temperature alloy bucket.

We use automatic consumable electrode welding instead of manual metal arc welding. It gives us high travel speeds (50 to 75 ipm), higher deposition rates (about half the number of weld passes are needed) and excellent quality with a minimum of rework necessary.

We selected equipment with rising volt-ampere characteristics to join a cast cobalt-base



WELD SET-UP calls for close attention to torch angle and nozzle height. Wheel is in flat position (top) for passes 1, 2, 4 and 6. It is tilted 25° (bottom) for bucket passes 3 and 5.

high temperature alloy bucket and a low alloy forged and heat treated AISI 4340 steel hub. We selected Type 19-9 WMo (Type 349) filler metal which had been successfully applied as a manual electrode on earlier designs.

Joining of individual buckets to a turbine wheel hub is a difficult problem regardless of the welding methods used because of cracking. In fact, the joint itself resembles a crack sensitivity test developed at the Naval Research Laboratory to evaluate the welding characteristics of materials.

Therefore, special care was taken to develop joint designs and welding procedures which would minimize four types of cracking: radial, fusion line, transformation and centerbead.

Radial cracking: Cracks emanate from the bucket separation and extend into the weld, aggravated by the circumferential stresses induced in welding a complete circle. This radial cracking can be explained in terms of the weld's solidification pattern. Molten weld metal solidifies from the joint walls inward to the center and at right angles to the joint walls. At the bucket separation, there is no cold wall to initiate the chilling of the molten weld. Therefore, this area is the last to solidify and the liquid film present there cannot support the contractual weld stresses and cracks. In addition, low melting phases and foreign materials precipitate in these areas and further contribute toward cracking.

Radial cracking is further aggravated by automatic welding because the rapid solidification of the molten weld metal increases the contractual stress levels over those encountered in manual welding. Limits for acceptable radial cracking must be established for each turbine wheel application, depending on service conditions.

Fusion line cracking: Fusion line, or circumferential cracking, extends in a circumferential direction around the wheel, between the bucket material and the weld. It is associated with

the specific composition of the bucket alloy and is quite pronounced in the material employed in this study.

Chrome-moly carbides present in little islands in the matrix of this alloy contribute to its high temperature strength. During welding, these carbides go into solution and precipitate out in a continuous chain during solidification and cooling, after welding. This same phase is present if welded with or without preheat, and would occur on heating and cooling without welding, although they would be well dispersed.

This chain of carbides contributes to circumferential cracking since it possesses a relatively low melting point and is the last area to solidify. Thus, if it is subjected to high weld shrinkage stresses while still in a liquid film state, cracking occurs in a manner similar to other "hot short" materials.

The extension of circumferential cracking can result in bucket failures in service. While limits depend on the particular application, no circumferential cracking was permissible on this particular wheel.

A marked decrease in circumferential cracking is brought about with automatic welding because the time at elevated temperatures is reduced to the extent that solution of carbides is minimized. Further, those carbides which go into solution are prevented from segregating into chains because of the rapid solidification and cooling rate.

IN SETTING UP for automatic welding, individual buckets are fixtured against the hub and held in proper alignment by locating from the foil section of each bucket.

Transformation cracking: This is associated with the hub material, in this case an AISI 4340 alloy steel containing .40 percent carbon. This material hardens when quenched from temperatures above 1300°F because of an allotropic change. If the cooling is slow—approaching the equilibrium conditions — then the resulting structure is soft and ductile. When cooling is rapid, such as that following welding, the structure is martensitic and highly stressed, hard and brittle. In combination with residual weld stresses, brittle fracture may result. Preheating slows down the cooling rate, prevents the martensite transformation and eliminates cracking. That's why we used preheating throughout this investigation. It does not alleviate radial or circumferential cracking. Post heating is used to isothermally transform the austenite to a lower stressed bainitic structure. The final assembly is later fully stressed annealed to minimize residual welding stresses and transform the bainitic structure.

Center-bead cracking: This cracking is associated with the weld configuration and solidification pattern. Metal solidifies from the joint walls inward toward the center. If the center of the weld is in a liquid film state at the same time contractual stresses are present, cracking may occur. A narrow, deep weld is particularly susceptible to this type of cracking. The use of proper joint designs and welding pass sequence can eliminate it. Since center-bead cracks progress in a circumferential manner, none are permitted.

Procedure development: Most of the experimental development welding was carried out with grooved plates of cold rolled steel simulating wheel configurations, with the exception of the bucket separations. Occasional wheels were welded to verify results.

A joint suitable for manual welding (double U) proved unsatisfactory for automatic welding because the increased penetration resulted in burn-through. Copper-backing of the underside did not alleviate the situation and, in fact, was detrimental because of fusion of the copper back-up ring by the filler material.

Backing of the joint with a shoulder on the hub material which mates with the contour of the bucket base solved the penetration problem by acting as a heat sink. However, the narrow bucket burned away and permitted damage to the bucket air-foil section. Therefore, the bucket was redesigned with a V-preparation to provide a wider bucket base.

When the redesigned bucket was used in conjunction with a single V-groove on the hub, back-up by the hub material, center bead cracking was observed when welding with a single pass and the groove was too narrow for multiple passes.

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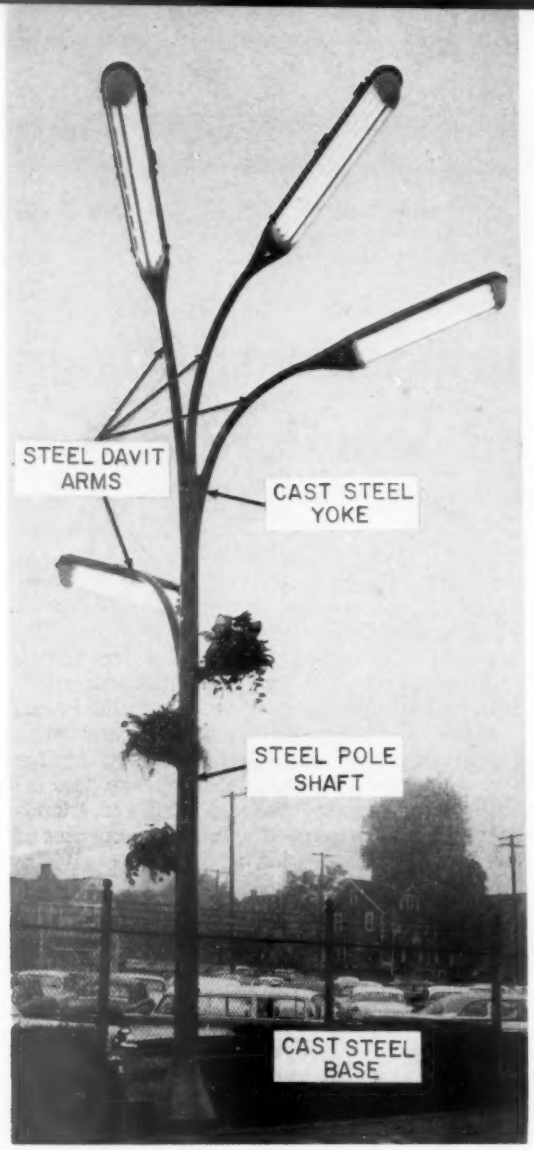


Composite Welded Design Has Flexibility

IN BRIEF: Welding permits using a variety of metals and metal shapes and thicknesses without increasing production costs of ultra-modern light poles.

STREET LIGHTING OF THE FUTURE became a reality in Chicago recently when an electronic signal energized 280 powerful fluorescent lamps. These lamps now bathe seven blocks of State Street's shopping district in a sea of light—making it the most brilliantly lighted street in the world.

Playing a key role in the half-million dollar project are 70 revolutionary welded street light standards engineered and manufactured by Union Metal Manufacturing Co., Canton, Ohio.

Welding played a key role in the engineering of these poles, since fabricating by any other method would have been practically impossible. The fast and versatile welding processes permitted reliable joining of a variety of metals, metal thicknesses and shapes without increasing production costs.

Steel-to-steel: Strong, lightweight and hollow pole shafts and four davit arms — each of which mount a 7-foot long, 170-pound General Electric fluorescent Luminaire — are made by automatic submerged arc welding. Seams are made using 5/32-inch diameter wire and suitable flux. Welding is done at 26 to 30 ipm using 700 to 800 amps direct current and reverse polarity.

Shafts are cold rolled to shape from 5/16-inch

continued on page 46

WELDING DAVIT ARMS to the top of the main shaft is done after cast steel base has been welded to the shaft's bottom.

Davit arms are positioned for welding in a special jig (left). Then welds are made (center) and ground (right).

PART THREE / In a series of three articles

Manufacturing: Joint Design And Standardization

by **JOHN MIKULAK,** *Assistant to Vice President of Manufacturing, Worthington Corp.*

SCIENTIFIC WELDMENT DESIGN relies heavily on standardization, on joint design, and on stresses in parts under load. Furthermore, these scientific designs often save their users a good deal of time and money.

When you're mass producing something, it goes almost without saying that you cannot ignore scientific design. And you really can't ignore it in less-than-mass production either. Even job shop work—short runs—deserves and justifies good design.

STANDARDIZATION

The chief recognized advantage of welded design is the freedom in design changes. It's a noble attribute, but too often it has been abused. Standardization is a noble attribute too. Not only does it lower cost, it makes for dependable performance. Many heavy machine manufacturers who call themselves custom builders can do much to standardize. They can standardize their materials, shape and sizes. This makes for more economical purchasing, less scrap, less inventory, and higher inventory turnover. Standardization also helps cut the indirect expenses of storekeeping and accounting.

These custom manufacturers can also standardize structural shape configuration and joint design. They could settle details of reinforcing members that take accessories such as bearings, hinges, bolt supports, flanges, ring supports, bolt

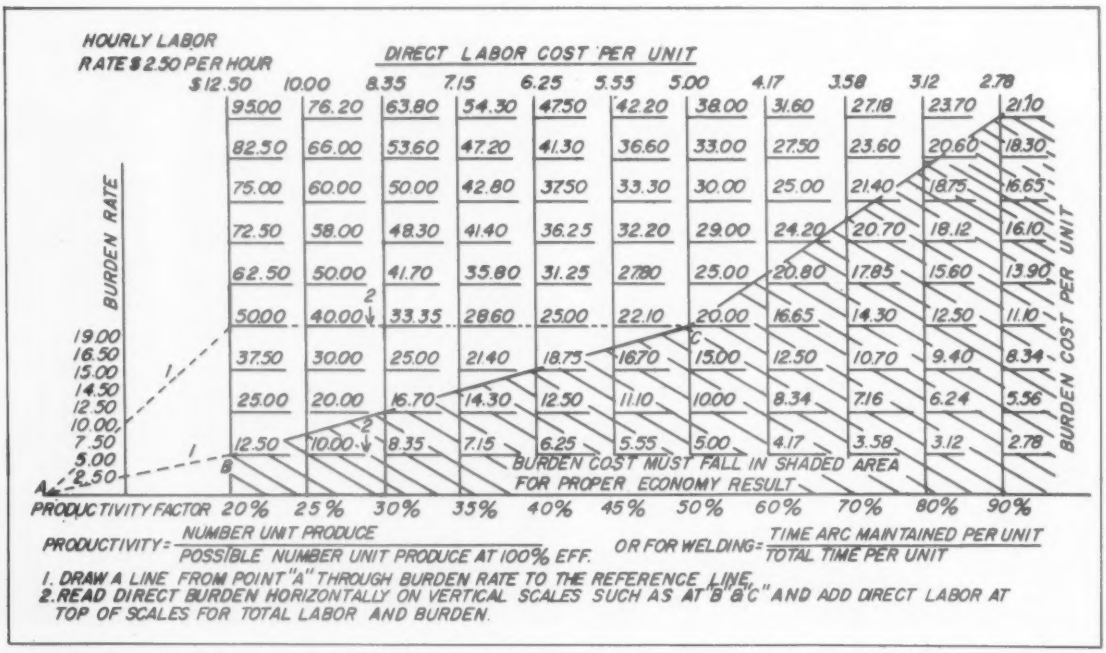

HOURLY LABOR RATE $2.50 PER HOUR
DIRECT LABOR COST PER UNIT
$12.50 10.00 8.35 7.15 6.25 5.55 5.00 4.17 3.58 3.12 2.78
BURDEN RATE
BURDEN COST PER UNIT
BURDEN COST MUST FALL IN SHADED AREA FOR PROPER ECONOMY RESULT
PRODUCTIVITY FACTOR 20% 25% 30% 35% 40% 45% 50% 60% 70% 80% 90%
PRODUCTIVITY = NUMBER UNIT PRODUCE / POSSIBLE NUMBER UNIT PRODUCE AT 100% EFF.
OR FOR WELDING = TIME ARC MAINTAINED PER UNIT / TOTAL TIME PER UNIT
1. DRAW A LINE FROM POINT "A" THROUGH BURDEN RATE TO THE REFERENCE LINE.
2. READ DIRECT BURDEN HORIZONTALLY ON VERTICAL SCALES SUCH AS AT "B" & "C" AND ADD DIRECT LABOR AT TOP OF SCALES FOR TOTAL LABOR AND BURDEN.

FIGURE 1: Relationship of direct labor costs to burden costs on productivity.

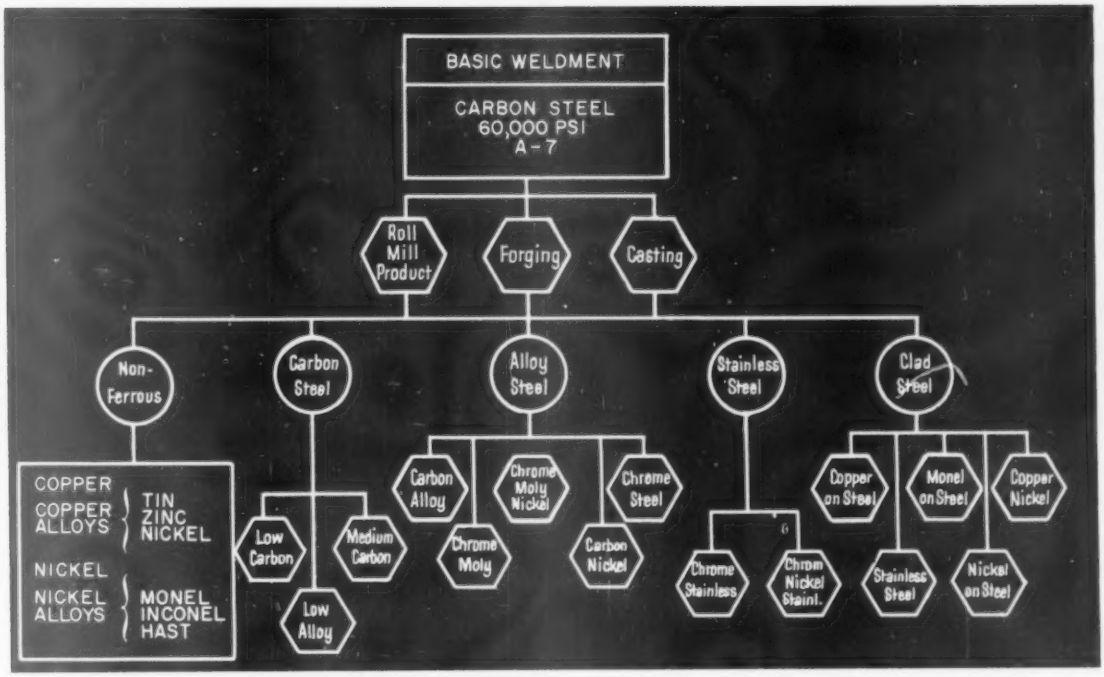


FIGURE 2: Types of materials that can be welded into an integral assembly.

sizes and bolt spacing. They similarly could, if only they would, standardize engineering drawings so that views, sections and notes are placed in specified places. With shop specifications standardized dimensions and cross sections standardized, one can keep manufacturing and accounting costs down. Standardization not only decreases the time it takes men to familiarize themselves with the job. It also encourages versatile jigging and short-cuts supervision and methods.

The welding industry is unusual because its materials and equipment, to a great extent, are foolproof. The workmen need less and less skill. This made much manpower for manufacture by welding. The welding industry, furthermore, is more versatile. It can utilize members produced by numerous fabrication processes. Its engineers and designers can select the most functional process, and use the best material for each member.

Figure 2 shows the extensive range of materials which can be used in a single welded structure.

The key to low shop cost is high productivity. It is extremely important when shops have high burdens. (See Figure 1.) When you are introducing new equipment and facilities it is important to understand not only how the boys in the shop think, but also how they think in the engineering, processing and standards departments. You see, you have to change the designs and methods to suit the new equipment to raise the productivity.

COST INCREASE IN WELDING POOR FIT UP

3/16" DIA. — E6013 ELECTRODE
D.C. DIRECT CURRENT
HORIZONTAL WELD POSITION

ROOT OPENING	CURRENT	NO PASSES	VOLUME INCREASE WELD	AV JOINT SPEED in./min	COST PER SLAGGED INCH CENTS	% INCREASE
0-1/32"	280			8.34	.722	100%
1/16"	280		1.56	5.34	1.13	157%
3/32"	260	2	1.89	4.30	1.36	188%
1/8"	260	2	2.25	3.61	1.62	224%
5/32"	250	3	2.64	3.01	1.93	268%
3/16"	250	4	3.06	2.60	2.24	310%
7/32"	250	6	3.52	2.26	2.58	357%
1/4"	250	6	4.0	1.98	2.93	406%

FIGURE 3: This is what happens to cost when you have poor fit up.

To cut direct shop costs, use higher melt-off rated electrodes. Or use inexpensive automated equipment to substantially increase melt-off. Due to negligible difference in indirect expense the shop cost decrease is nearly proportional to one-half of the melt-off rate. Electrodes of iron powder grades are desirable over the reversed polarity XX10 type. The semi-automatic gaseous-and submerged-shielded arc processes are also desirable because their melt-off rates are 2 to 6 times those of iron-powdered electrodes. The increase in capitalization cost is negligible.

With an arc factor of 20 to 50% in manual electric arc and 40 to 80% in semi-automatic submerged arc, you can quite easily appreciate a 250% gain in actual joint metal deposition. Let's

PROCESS METHODS

TYPE	SIZE	SAWING	SHEARING	TORCH CUT	FORMING	MACHINING
ANGLE TEE CHANNEL I BEAM	THRU 4"	FRICTION 1 ABRASIVE 2 CIRCULAR 3 POWER H 4	POWER PRESS 1 POWER BRAKE 2 HYDRAULIC PRESS 3	HAND 1 PORTABLE 2	POWER BRAKE 1 PYRAMID BAR ROLL 1 HYDRAULIC PRESS 2 WRAPPER ROLL 2	MILL 1 PLANNER 2
ANGLE TEE CHANNEL I BEAM	OVER 4" THRU 10"	FRICTION 1 POWER H 2		HAND 1 PORTABLE 2	HYDRAULIC PRESS 1 PYRAMID ROLL 2	MILL 1 PLANNER 2
TUBING	THRU 2½"	ABRASIVE 1 FRICTION 2 POWER H 3 BAND SAW 4			POWER BRAKE 1 BAR ROLL 1 HYDRAULIC PRESS 2	LATHE 1
TUBING	OVER 2½" THRU 6"	FRICTION 1 POWER H 2 BAND SAW 4		HAND 1 MACHINE 2	POWER BRAKE 1 HYDRAULIC PRESS 2	LATHE 1
BAND AND STRIP	THRU ⅛"x3"	ABRASIVE 1 FRICTION 2 POWER H 3 BAND SAW 4	PUNCH PRESS 1 POWER BRAKE 2		PUNCH PRESS 1 BAR ROLL 1 POWER BRAKE 2 HYDRAULIC PRESS 3	
PLATE	THRU ⅛"	BAND SAW 1	POWER SHEAR 1 CIRCLE SHEAR 1 NIBBLER SHEAR 1	PANOGRAPH 1 PORTABLE 2 HAND 3	POWER BRAKE 1 PLATE ROLL 1 HYDRAULIC PRESS 2	
PLATE	THRU ½"		POWER SHEAR 1 CIRCLE SHEAR 1 NIBBLER SHEAR 1	PANOGRAPH 1 PORTABLE 2 HAND 3	POWER BRAKE 1 PLATE ROLL 1 HYDRAULIC PRESS 2	PLANNER MILL 1 BORE MILL 1
PLATE	OVER ½"			PANOGRAPH 1 PORTABLE 2 HAND 3	POWER BRAKE 1 PLATE ROLL 1 HYDRAULIC PRESS 2	PLANNER MILL 1 BORE MILL 1
BAR	OVER ½"			PORTABLE 1 HAND 2	POWER PRESS 1 BAR ROLL 1 HYDRAULIC PRESS 2	

FIGURE 4: Here are the most desirable and least desirable fabricating processes with various types of equipment.

assume direct labor cost is 18%, indirect cost 37%, and material cost 45%. With the increase in deposition rate using semi-automatic submerged arc you decrease shop costs about 20% (on basis of direct and indirect cost). The difference in melt-off rates would be about 45%.

Figure 4 shows the most and least desirable process for making components with the various sorts of equipment. There are many misconceptions in applying fabricating processes as well as welding processes. Perhaps they developed through habit and prejudice. A common remark heard in the weldery is, "while automatic processes melt-off at higher rates, manual welding is still cheaper." The argument is that automated welding needs good fits, which run up the cost. Cost statistics show that poor fit-up in manual electrode arc welding increases cost considerably. (See Figure 3.) If a job needs good fit-up it needs it no matter how you weld, automatically or manually.

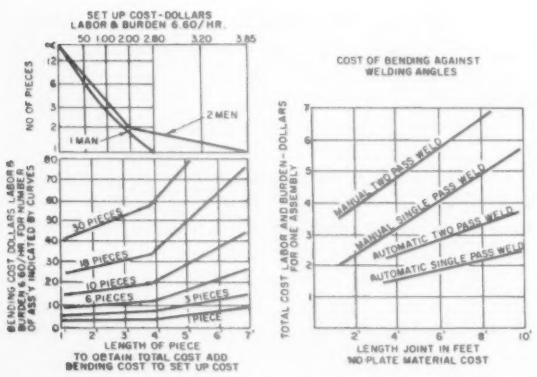


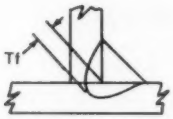
FIGURE 5: These are the costs of fabricating joints by welding and by bending.

Buying your material in the most useful shapes will not only reduce fabricating costs but will help turnout more precise work. Take a heavy piece of bar stock 1¾" x 6". It's 20% straighter than plate. This cuts your shop costs because you have no straightening or cutting to do.

Incoming inspection is also important. It may cut your costs a lot by avoiding the extra work you otherwise would have in fabricating material not within commercial limits specified by vendors.

There are many jobs an abrasive cut-off saw will do quicker and more accurately than a torch. The abrasive cut-off saw can also beat a power hacksaw. It can cut up to 3-inch diameter solid bar, and shapes fitting within an 8-inch diameter.

The press brake should be considered a very important tool for economy in production by welding. A good example of welded fabrication



TYPE OF ELECTRODE OR PROCESS	PERCENT PENETRATION (Tf) OF MINIMUM LEG SIZE				
	0	10	15	25	35
E-XX10		X			
-XX11		X			
-XX12	X				
-XX13	X				
-XX14	X				
-XX15			X		
-XX16			X		
-XX18		X			
-XX20			X		
-XX24	X				
-XX27		X			
-XX30			X		
CO_2 Metal arc					X
Inert metal arc				X	
Semi or automatic submerged				X	
Hollow flux tube				X	
Dual shield (CO_2)					X
Magnetized flux				X	

ROOT PENETRATION FOR SINGLE PASS FILLET WELDS

FIGURE 6: Here is percentage root penetration for single pass welds.

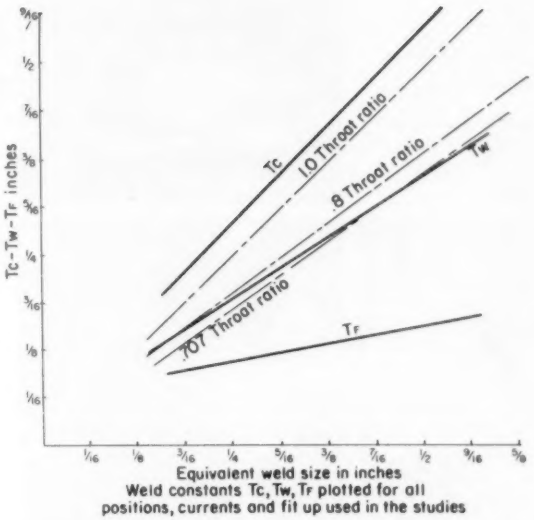


FIGURE 7: Here are weld constants plotted for all positions, currents and fit ups.

and using a press brake was illustrated and described in "Highway Guard Rails Are Designed For Welded Fabrication." (INDUSTRY & WELDING, April, 1959, page 46). To use a press brake economically, the design should specify a radius of one value though various plate thicknesses may be used. The shop should use air bending and select a female die which is 8 times the average thickness used on the design or in general manufacture.

Figure 5 illustrates the difference in cost of fabricating joints by welding and by bending.

JOINT DESIGN

A major waste in welded design is improper joint selection and overwelding. The strength of welds is determined by the penetration in weld deposit. (See Figure 6) For fillet welds the additional strength obtained by fusing the parent material by the energy of the arc is not provided for and perhaps is a carry-over from the design of EXX12-EXX13 electrodes. This type of electrode was designed for welding over poor fit-up in joints. Newer electrodes such as EXX14-EXX24 are also designed for shallow penetration.

Other electrodes, such as EXX10-EXX15 and semiautomatic processes, such as the submerged, inert metal arc, and CO_2 arc, by design intent, penetrate deeply to give the same degree of strength assurance as the shallow buildup of the E6012-13-14 and 24 electrodes. Figure 7 shows the expected throat depth of fillet welds with the semiautomatic submerged arc manually operated. You can see that a throat depth equal to the minimum leg size would be more conservative than the value of 0.707 times the leg size we now use. A conservative standard would be to allow 20% of the minimum leg size as throat depth penetration to be added to the throat of the weld deposit. This standard would save 28% of weld cost, and lower cost 7%.

Unnecessary welding and fitting is wasteful on such as corner joints, where fit-up is generally poor and where extra grinding and cleaning are needed for appearance. Most corner joints are merely imitations of cast corners, feeble attempts to give weldments the radius the foundry would give. An unbalanced T-joint is ideal for the weld shop because it's a cheap joint. Don't specify a joint strength of higher value than the plate material. Too high a joint strength is unnecessary and generally unwise, because the increased stiffness produces higher stresses than you normally would get with a joint of strength equal to the parent plate. In many applications particularly static loads or structures transmitting longitudinal shear in members for stiffness, complete penetration of joints may be harmful. • •

Flash Welded Flat

IN BRIEF: Engineered production, selection of proper material, good joint preparation and correct flash welding techniques make possible high volume production of house trailer rims.

1. Circle
2. Coin and shear
3. Flash weld
4. Draw and trim
5. Form
6. Roll

A CRACKLING ARC and a shower of sparks is what you see when they flashweld a rim at Goodyear Tire & Rubber Co., Metal Products Division, in Akron, Ohio.

Flash welding is nothing new there. Design is suitable for flash welding. Since their start 38 years ago, they have added many flash welding lines to give them facilities to fabricate a complete line of rims. They make rims for farm implements, trucks, off-the-road giant earth-movers, and their newest, the mobile home rim for house trailers.

The engineers at Metal Products discovered that the way to get good flash welds is to rigidly control the welding procedures.

The mobile home rim is made of rimmed steel. Here's what takes place in production from start to finish. The rimmed steel comes from the mill in a given band edge width and specified length. First they pickle it, because you need clean material for quality welding. Also, dies and rolls last longer on clean material.

First, they feed the flat sheet into a circling machine that forms it into a donut shape. As the stock goes through the circler it stamps the Goodyear trade name and date. Then the machine automatically ejects the donut onto a conveyor.

Second, the donut moves to a 150-ton mechanical press where it is coined and sheared. To make good flash welds the edges must be uniform and true, square and clean, when they enter the welder, and everybody at Metal Products knows it.

Third, the part is welded on a fast cam-operated 750-KVA flash butt welder. The operator loads the part onto a set of class III copper electrodes, steps on a foot pedal, and clamps the part with coarse jaws. As he releases the pedal, flashing begins. An automatic ejector kicks the part out onto a chain belt conveyor which moves it

Stock Can Be Cold Worked

to the next operation.

Fourth, immediately after welding the hot flash is draw trimmed. They remove the weld uniformly. The weld surface and parent metal surface then are of the same thickness. This operation is important, because any irregularities in thickness or scratches in the weld would make it inferior under the extreme cold working the rim gets throughout the rest of its manufacture. Blades are thoroughly checked and often replaced. Set-up of draw trim blades are set to given specifications, and are followed diligently.

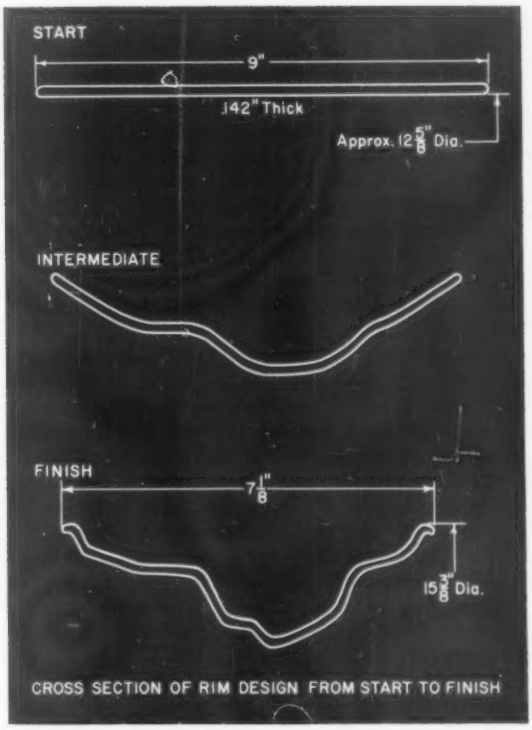
The supreme test of the weld comes when the cylindrical donut is formed in a 750-ton press. This prepares the rim for rolling. At this point, weld and parent metal are elongated 23%. This operation immediately gives a good indication of the quality of your weld. From here, the cylindrical donut starts to take the shape of a rim.

After forming and a series of rollings, the rim takes final shape. This is made possible because they use highly polished rolls and dies with high lubricity oils on them.

To bring the rim within tolerances and shape specifications, they expand it in a 300-ton press. The inspector then checks the rim shape with a contour gauge, the tire bead seat with a ball tape, and the rim mounting on a wheel mounting mandrel. Every rim is fully inspected.

The last and final operation embosses valve hole locators and punches the valve holes. The rim goes onto an overhead conveyor, which carries rims to the washer and painter. The rims are coated with a baked aluminum. • •

INSPECTOR CHECKS rim with a contour gage. Operator at rear performs final operation—embossing valve hole locators and punching valve holes.



CROSS SECTION OF RIM DESIGN FROM START TO FINISH

the world's largest ditch digger is welded for maximum strength as . . .

Welding Simplifies Manufacturing, Makes Engineering Changes Easy

IN BRIEF: Formed and machined steel parts, which replace castings, are welded by iron powder electrodes.

THE WORLD'S LARGEST ditch digger, the Model 330 made by Gar Wood Industries, Inc., is fabricated almost exclusively by welding formed and machined steel parts. By using as few castings as possible, Gar Wood simplified manufacture and made engineering changes easy.

The purchased 220-hp diesel engine, the hydraulic components for control of the steering mechanism and the boom, and certain other controls, were the only portions of the ditcher not fabricated.

The 115,000-pound machine can dig a ditch six-feet deep, 22-feet 7-inches wide at the top and 4-feet 7-inches wide at the bottom. It will be used to dig irrigation ditches in a five-year reclamation project in Cameron Country, Texas.

Among the interesting features of the ditcher are the trapezoidal attachments which bevel the edges of the ditch. Suspended from the sides of the machine by welded frames, they can be trimmed to vary the contour of the ditch.

Conveyors used to discharge the earth are suspended by welded steel frames. They are arranged so discharge can be on both sides or either side. Speed of discharge is controlled independently from that of the digging blades and the forward speed of the entire machine.

Construction of the machine began with the welding together of I-beams and C-beams to form the frame. Mounts for the engine, canopy and all-weather, removable operator's cabin were welded into place, and the fixtures to hold the 28-inch crawler treads and rubber-tired wheels were then welded on.

Braces for the front frame from which the ditching boom was to be suspended were welded in position as was the boom itself. The 16-foot diameter wheel, complete with the scoops, was also fabricated by welding steel components in place.

Other weldments included the curved and pointed wheel guard, the canopy over the engine compartment, the operator's cabin and the sheave blocks.

The machine is capable of traveling over the road at two miles an hour when not digging. While ditching, it is capable of speeds up to 35 fpm, depending on the depth of the cut being made and the condition of the earth being removed.

The majority of the welding electrodes were supplied by Metal & Thermit Corporation. Most of the work was performed with Murex E-6024 iron powder-type electrodes, but some E-7028 low hydrogen-type iron powder electrodes were also used. • •

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How To Specify Joint Clearance For Brazing Dissimilar Metals

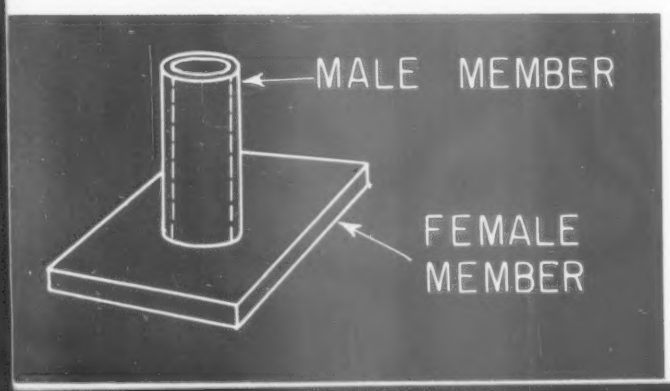
IN BRIEF: The accompanying nomograph can help eliminate the time-consuming trial-and-error methods usually needed to determine proper joint clearance for brazing dissimilar metals.

DISSIMILAR METALS often create a tricky brazing problem. Because the different parts of the assembly do not expand equally during the brazing cycle, the joint gap at *brazing* temperature can differ greatly from its dimension at room temperature. Unless this dimensional change is properly compensated for in the specified joint clearances, the brazing alloy may be unable to provide a satisfactory joint.

A common type of joint—a tube and socket assembly—in which differential expansion can be particularly troublesome is shown below. In such a joint, if the female member is the high expansion metal, the clearance—nominally correct at room temperature—may become so enlarged at brazing temperature that the filler metal can not fill the joint gap. Conversely, if the female member has the smaller expansion coefficient, the clearance at brazing temperature may be reduced so much that the small amount of alloy drawn into the joint is either highly stressed or ruptured when the gap tries to enlarge again as the assembly cools.

When joining dissimilar metals, it usually is necessary to braze at least several trial assemblies having different initial clearances to select the most satisfactory clearance. Much of this time-consuming trial-and-error approach can now be eliminated with the help of the accompanying nomograph. This nomograph provides a quick method for predicting how much the joint gap will change during the brazing cycle.

UNEQUAL EXPANSION of dissimilar metal members during the brazing cycle can appreciably alter the room-temperature clearance in a simple-looking tube-and-socket assembly.



The method was developed by D. C. Herrschaft, Assistant Manager, Brazing Products Division, Handy & Harman.

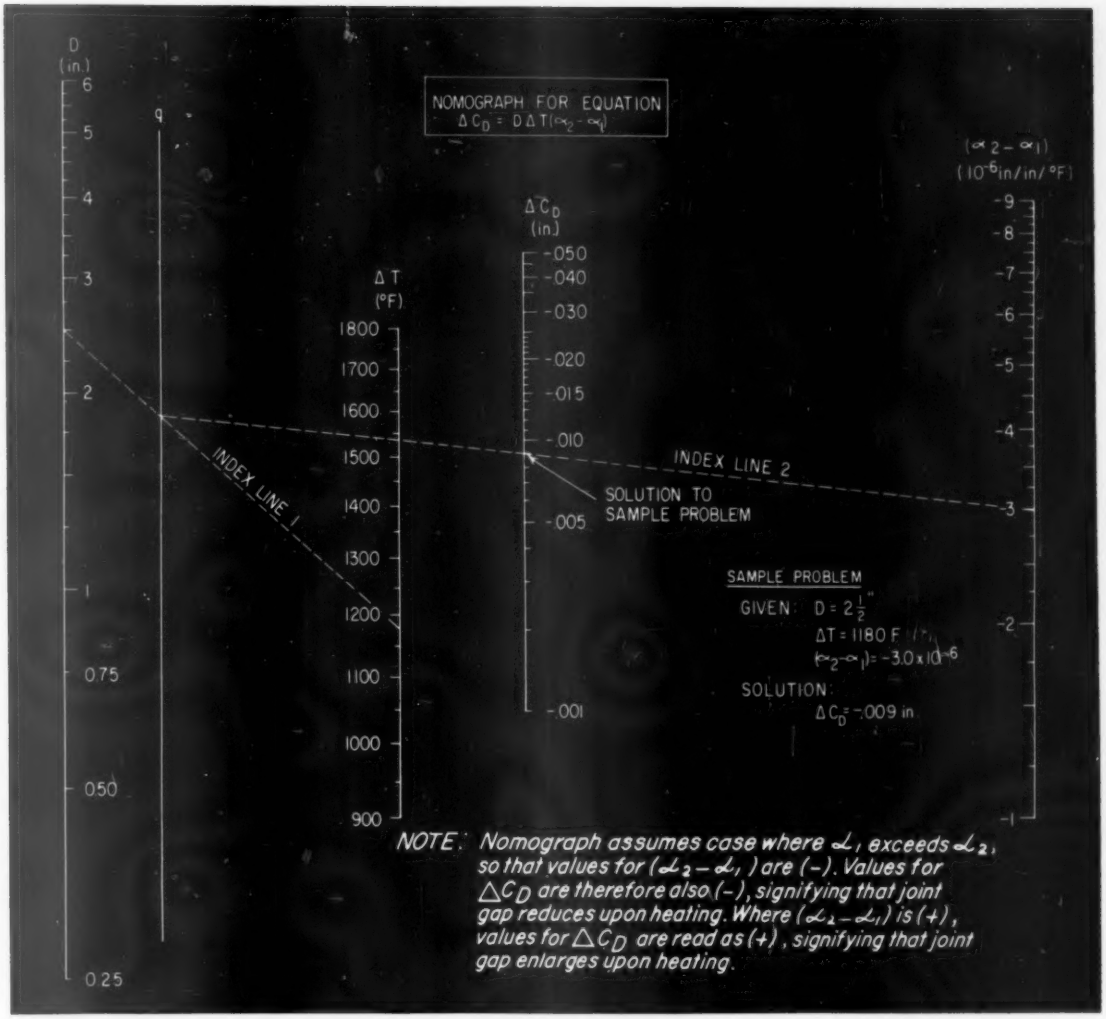
By knowing the magnitude of the change, one can surmise whether the gap will be too large or too small to be brazed successfully. And one can anticipate how much the layer of brazing alloy will be stretched if the gap tends to expand on cooling. Stretching of the alloy layer in the brazed joint (which occurs when the male member has the larger expansion coefficient) sets up stresses which can seriously weaken the joint. On the other hand, moderate compression of the alloy layer on cooling (i.e., the female member has the larger expansion coefficient) strengthens the joint by shrink-fit.

The amount of internal stress that can be tolerated varies with the type of assembly because it depends on the ductility of both the filler metal and the base metals involved. However, a good rule-of-thumb is that the layer of alloy should not stretch more than 50% in thickness upon cooling to room temperature. Based on the change in gap width during brazing, as indicated from the nomograph, one can therefore select a starting clearance to prevent the alloy from undergoing more than 50% *theoretical* elongation when the joint cools. Theoretical elongation assumes that all the stretch is concentrated in the filler and none occurs in the base metals. In actual practice, some stretching does occur in the base metals (depending on ductility) due to plastic behavior while the assembly cools down from the brazing temperature. However this provides a safety factor by relieving some of the stress on the brazing alloy layer.

The more serious problem when brazing dissimilar metals arises when the layer of brazing alloy is subjected to tensile stress as the reduced joint gap enlarges upon cooling. Therefore the following procedure is of greatest concern when the female joint member has a smaller expansion coefficient than the male member. The examples given (opposite page) deals with that situation.

Selecting the initial room-temperature *diametral* clearance involves two simple steps. First, determine from the nomograph the amount of gap change that occurs during heating to the brazing temperature. Second, multiply the value obtained from the nomograph by 3. This establishes the room-temperature *diame-*

continued on page 72



HOW TO SOLVE A SAMPLE PROBLEM:

Here's how to use the nomograph to find $\triangle C_D$ and then select the diametral clearance to limit the theoretical elongation to 50% when the male member has the higher expansion coefficient.

Problem: A 2½-in. diameter cartridge-brass tube is to be brazed into a carbon steel plate using BAg-6 filler metal. Select the room-temperature clearance for the first trial braze.

From a metals handbook:

α^2 (carbon steel) $= 8.61 \times 10^{-6}$ in./in./°F (mean coeff., 75 to 1200 F)

α^1 (cartridge brass) $= 11.60 \times 10^{-6}$ in./in./°F (mean coeff., 75 to 1200 F)

Solidus temperature for BAg-6 = 1250 F

Therefore, the working values are:
D (nominal diameter) = 2½ in.

$\triangle T$ (net temperature change in brazing cycle) = 1250 − 70 = 1180 F

$(\alpha^2 - \alpha^1)$ difference in expansion coefficients = $(8.61 - 11.60) \times 10^{-6} = -2.99 \times 10^{-6}$ in./in./°F

SOLUTION:

Step 1: Lay off index line 1 connecting the 2½ in. value on the D scale and the 1180 F value on the $\triangle T$ scale.

Step 2: From the point where index line 1 intersects the q-line extend index line 2 to the value -2.99×10^{-6} (use −3.0) on the $(\alpha^2 - \alpha^1)$ scale.

Step 3: Where index line 2 intersects the $\triangle C_D$ scale, read the resulting change in diametral clearance. The result is −0.009 in., indicating the diametral clearance will shrink by that amount when the parts are heated from 70 to 1250 F.

Step 4: Multiply $\triangle C_D$ by 3 to give a 50% theoretical elongation in the filler metal on cooling. A desirable initial diametral clearance = .009 × 3 = .027 inch (or .0135 in. radial clearance). This represents a good starting point for the first trial braze.

COMPOSITE WELDED DESIGN

continued from page 35

plate and then welded. They taper gracefully from a 12-inch diameter base to a 9.2-inch diameter top.

Davits are welded first and then bent to shape.

Castings-to-steel: A cast steel base is welded to the bottom of the pole shaft and a cast steel yoke is welded to its top. Three of the four davit arms — the highest of which is 36-feet above the street — are welded to this yoke. (The fourth mounts a Luminaire parallel with and over the sidewalk at a height of 24-feet.)

Castings are ground and poles shafts flame cut and ground to get a 60° included welding angle.

Castings are preheated to prevent cracking. Sections up to ½-inch thick are preheated to 100°F. Heavier sections are heated to 200°F.

When joining cast bases and yoke to the pole shaft all root passes and remaining filler passes —when out of position—are made with 3/16-inch diameter E6011 electrodes at 190 amp, alternating current. When welds can be positioned, filler passes are made with 3/16-inch diameter E6014 electrodes at 230-250 amps, alternating current.

Yoke castings are joined to davit arms using 5/32-inch diameter E6011 electrodes at 140-160 amps, alternating current.

Another unique feature of the lighting standards is an attractive set of three cast aluminum flower bowls which hold seasonal plants and flowers. A special welded plumbing system is built into each pole to drain excess water away from bowls which are plumbed into a corrosion-resistant aluminum drain pipe, complete with stainless steel fittings and rubber hosing.

Aluminum-to-aluminum: Couplings in the 2-inch aluminum pipe were welded by the tungsten inert arc process. A ⅛-inch diameter tungsten electrode and ⅛-inch diameter 4043 aluminum filler rod were used. Argon shielding gas used flowed at 20 cfh. 140 to 160 amps alternating current with superimposed high frequency current was used. Welding was done at six to ten ipm.

Stainless-to-carbon steel: The stainless pipe fittings threaded into the aluminum couplings were welded to the carbon steel poles using ⅛-inch and 5/32-inch E309 electrodes. The former were used at 80 to 100 amps direct current and reverse polarity. The latter were used at 120-130 amps direct current and reverse polarity.

Stainless-to-stainless: Similar welding techniques were used for joining stainless parts. Excess lengths of stainless pipe were removed by carbon arc-compressed air gouging pipe ends before they were ground flush. Gouging was done using a 5/16-inch carbon at 300-350 amps direct current and reverse polarity. • •

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Know Your Filler Metals

PART I of three

by **ORVILLE T. BARNETT,** *asst. mgr.: Metals Research, Armour Research Foundation, Illinois Institute of Technology*

TABLE 1: AWS-ASTM SPECIFICATIONS FOR FILLER METALS

Description	Year Issued
Gas rods	1946
Mild steel electrodes	1958
Low-alloy steel electrodes	1958
Cast iron	1956
Automatic wires	—
*Stainless steel electrodes	1955
†Stainless steel rods	1953
*Aluminum electrodes	1943
†Aluminum rods	1957
Copper electrodes	1957
Copper rods	1957
*Nickel electrodes	1954
†Nickel rods	1956
Surfacing	1956
Brazing	1956
Soldering	—
Tungsten	1955

*Covered
†Also bare electrodes

IN BRIEF: A leading authority gives a clear, concise—and very useful—explanation of filler metal specifications.

THERE ARE MANY MORE FILLER METALS today than there were even a few years ago. The number of mild steel electrode specifications, for example, has almost doubled since 1955.

The job of keeping specifications abreast of filler metal changes has been a big one, and the American Welding Society has done an excellent job of it. Of course, there have been lags—an example is E 6010 Fe, which has not yet been listed.

There are 17 active specifications for filler metals (see Table 1). They do not include specifications for automatic welding wire—but this important need is in the works now. Soldering filler metals may never appear in specification form — the Soldering Manual may take its place.

Anyone dealing with filler metals must understand specification numbers. Let's take mild steel electrodes because most other filler metals follow a similar identification system.

ORVILLE T. BARNETT *holds a B. S. degree from the Armour Institute of Technology. He has an extensive background in metallurgy, welding and brazing: Served with U.S. Steel; Black, Sivalls & Bryson; Metal & Thermit Corp.; and A. O. Smith Corp., before joining Armour. Mr. Barnett has published many articles and a book: "Filler Metals for Joining," released earlier this year.*

- The prefix always covers the type of filler metal: E for electrodes; R for rods; ER for electrodes and rods (for either oxyacetylene or tungsten arc); and B for brazing rods. It is also possible to have such combinations as ER or RB, or even ERB, but they aren't now used.
- The first two numbers of mild steel electrode specification numbers represent the minimum tensile strength of the as-welded deposit, in thousands of pounds. For example, 45 stands for 45,000 psi minimum.
- The third specification number—1, 2, or 3—indicates welding position. Number 1 means you can use the electrode in any welding position: Flat, vertical, overhead, and horizontal. Number 2 limits the electrode's use to two positions—flat, and horizontal fillet welding. Number 3 indicates flat position use only.
- The fourth number represents the type of coating on the electrode (Table 2). The only confusion: 0 stands for both cellulose sodium *and* iron oxide, while the other numbers identify but one chemical type. This confusion quickly clears if we take a look at the third number. If it is 1, like in E 6010, the coating is a cellulose sodium type; if 2 or 3, like E 6020 or E 6030 electrodes, you'll know the coating is an iron oxide type. Eventually, this problem may be resolved with the adoption of the vacant number 9.

The fourth number is also a guide to the type of power source to use. Some coverings are designed to be used with certain power sources; others, to produce specific weld metal proper-

key to correct current is the electrode coating composition—spelled out in each classification number

TABLE 2: RELATION BETWEEN COVERING AND CURRENT

Fourth Specification Number (EXXXX)	Description	Direct Current Polarity Straight	Direct Current Polarity Reverse	Alternating Current
0	cellulose sodium	—	■	—
	iron oxide	■	■	■
1	cellulose potassium	—	■	■
2	titania sodium	■	—	■
3	titania potassium	■	—	■
4	iron powder titania	■	■	■
5	low hydrogen sodium	—	■	—
6	low hydrogen potassium	—	■	■
7	iron powder iron oxide	■*	■	■
8	iron powder low hydrogen	—	■	■

*Preferred when using d.c. for horizontal fillets as with E6027

ties. The best power source for the second group has been etsablished through field tests.

We said the fourth number 0 refers to cellulose sodium or iron oxide. Cellulose sodium is strictly a direct-current (DC), reverse polarity type of covering; it cannot be used any other way. With iron oxide coatings, all power sources are possible choices. These are either DC, straight or reverse polarity, or alternating current (AC). Now that we have a choice, let's discuss which power source is best and why.

Where magnetic blow is not severe, DC, straight polarity will give the greatest production rate. However, where magnetic blow is bad, AC is the best choice because it eliminates blow. Its rate of deposition is second to DC, straight polarity. In last place, regarding deposition rate, is DC, reverse polarity. These figures are based on constant current; in practice, AC amperage may be higher than that used on DC and, as a result, deposit weld metal faster.

■ The fourth number 1 (cellulose potassium) coating works well on either DC, reverse polarity or AC. Actually, the electrode was developed as an AC counterpart of E6010 through addition of enough arc-stabilizing ingredients (mainly potassium) for acceptable AC welding.

■ Fourth number 2 (titanium sodium) coatings, found on the rutile or E 6012 types, were designed for DC, straight polarity, but were later improved through the addition of arc-stabilizing potassium compounds, to give good AC performance as well.

■ Fourth number 3 (titania potassium) electrodes were first designed for AC sheet metal welding, later developed for heavier metal welding. The exceptional arc stability of this electrode at low current (needed to avoid burnthrough on thin materials) has eliminated the old problem of arc pop-out. Operator training is made easier and quicker because of the arc-stability of this electrode.

■ Fourth number 4 (iron-powder titania) electrodes are really a counterpart of the third number 2 types. They contain considerable iron powder in the coating (which adds to the deposit) and because of their new balanced design, work well on all types of welding current.

■ Fourth number 5 (low-hydrogen sodium) electrodes work best on DC, reverse polarity. They are often called lime-base coatings — duplicating the popular stainless steel electrode coverings.

■ Fourth number 6 (low-hydrogen potassium) coverings are used on AC, or DC, reverse polarity. This group was developed as an AC counterpart of the low-hydrogen sodium type of covering, while retaining good performance characteristics of DC, reverse welding.

■ Fourth number 7 (iron powder iron oxide) electrodes are useful for AC or DC welding, either polarity. This is not surprising because this group is comparable to fourth number 0—iron oxide—coverings. However, DC, straight polarity is preferred for horizontal fillets. This same preference is true for the E 6020 and E 6030 electrodes. Again, though any power source can be used, remember that DC, straight polarity gives the best production speed.

■ Number 8 (iron powder, low-hydrogen) lime coatings are best suited for DC, reverse polarity or AC welding. Once more, the DC, reverse coating was modified to perform well on AC. • •

NEXT MONTH: The author discusses the relative popularity of various filler metals and the applications of each. He covers 10 important factors influencing filler metal choice.

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DEATH TAKES J. C. LINCOLN AND A. F. DAVIS

continued from page 24

tax, Mr. Lincoln ran for vice president of the United States on the Commonwealth Land Party ticket in 1924.

Mr. Lincoln wrote numerous pamphlets and books espousing the theory.

He was a member of numerous technical societies, including the American Welding Society from whom he received the Samuel Wylie Miller memorial award in 1934 for his contributions to the art of welding.

A. F. (Charlie) Davis

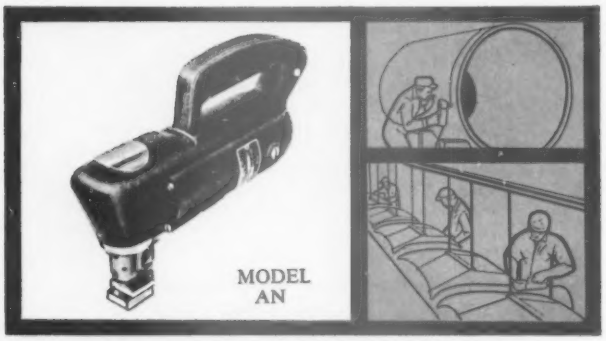
Mr. Davis started working for The Lincoln Electric Company in 1914, a few weeks after graduating from Ohio State University. After a period of sales experience, he was given responsibility for the company's educational program of developing a future for the then infant process of arc welding. He was still doing this at the time of his death, 43 years later, as the company's Vice President and Secretary, and Secretary of The James F. Lincoln Arc Welding Foundation. His fertile imagination, industry, drive and powers of friendly persuasion have done more to promote the cause of welding than those of any other one individual.

The following is only a brief listing of some of the projects he has fathered and guided for many years: he has operated the Lincoln School of Welding since 1917, having trained over 40,000 welding operators; he has edited and distributed free, to welding people throughout the world, the "Stabilizer" magazine for 30 years; he has published and sold over one million technical books on welding, among which is the Procedure Handbook of Arc Welding Design and Practice, now in its 11th Edition; he has published important articles in practically every trade publication in the field; conducted engineering courses in mechanical and structural design; distributed engineering information quarterly to the machinery and structures field; produced 5 motion pictures and numerous other teaching films; through the Lincoln Foundation, established over 500 welding libraries, published texts and case study books, sponsored competitions, awarded scholarship funds, produced numerous teaching aids; personally established the world's largest welding library at the Ohio State University and donated awards for papers on design through the American Welding Society.

Besides all these outstanding achievements, he has been the unseen hand behind many movements and activities that have been effective to advance progress in welding. He received the Society's Samuel Wylie Miller Medal in 1954.

He has also found time to be active in many community and civic projects, chief among which are the Y.M.C.A., Euclid-Glenville Hospital, Ohio State University Alumni activities, the Blue Cross Association, Arthritis Foundation, and the Future Farmers of America.

more news on page 58



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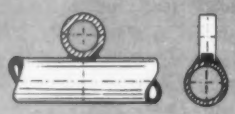
Design Hints For Using Welded Tubing

WELDED STEEL TUBING can be welded readily because it is made from the most weldable grades of steel. Joint design and tubing wall thickness are the two important factors in determining which welding method to use.

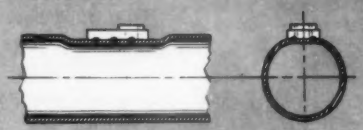
This report covers the common spot and projection welding methods used to join one tube to another or to join a tube to another metal form.

Next month similar design hints will be given for gas and arc welding and brazing of welded steel tubing. • •

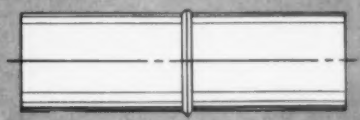
PROJECTION WELDING



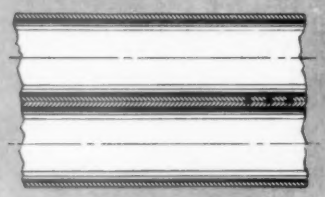
NARROW CONTACT area between a ring (or a tube) and tube provides sufficient concentration for welding current.



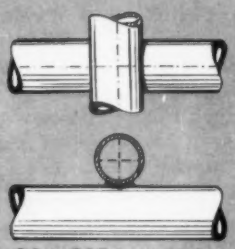
A NUT with ID threads and a tang is projection welded on the underside of the tang.



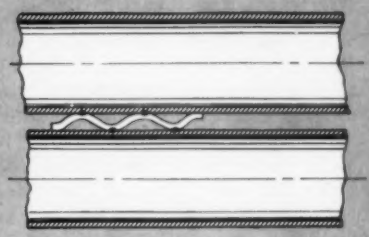
TUBE ENDS are flanged to 45° and projection welded to form a long length.



TWO TUBES can be projection welded side-by-side by forming nibs to concentrate current.

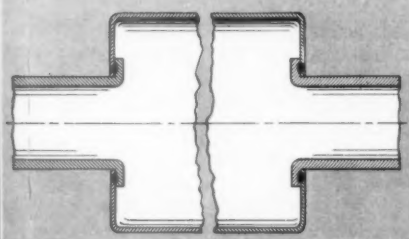


TWO OR MORE intersecting tubes are welded at the point of intersection.

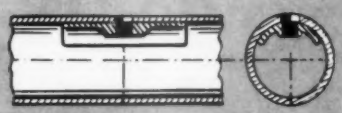


A FORMED STAMPING can be projection welded at contact points to produce a side-by-side tube assembly.

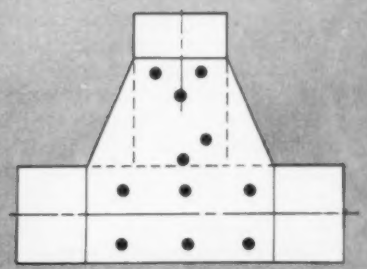
SPOT WELDING



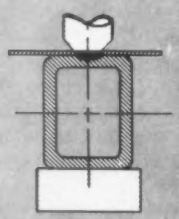
THIS IS THE WAY to weld assemblies involving two sizes and thicknesses of tubing.



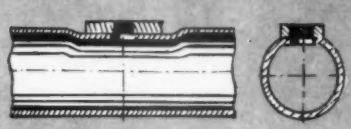
CUT A HOLE in the tube wall slightly larger than thread hole of a nut, then spot weld the nut with reinforcing pad to ID of tube.



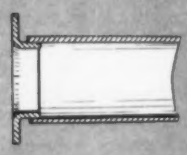
GUSSET PLATES may be spot welded to square tubing in angular (or multi-angular) joints.



THE INTERFACE weld area between a plate and a rectangular tube is immediately beneath the top electrode.



A NUT is spot welded to the flattened area of a tube for attaching to hanger, stud or bolt.



SNUG, TELESCOPIC FITS can be made by slipping the larger diameter over the smaller and spot welding.

AUTOMATIC WELDING

continued from page 34

Consequently, the hub was machined to a single J-groove, self-backing. After depositing one pass on the groove side, the backing was machined out to the center of the wheel to insure complete penetration and a concentric groove for the second side. If the second side is not machined to center, lack of penetration may result.

In early developments, we had difficulty with voids at the weld overlap (start and stops). This problem was solved by using a "running start" in which the wheel was rotating when the arc was started, and by proper adjustment in starting wire feed. Two passes per side were sufficient in the original development wheel design and a satisfactory procedure was established, using $\frac{1}{16}$-inch diameter filler wire. However, redesign of the wheel to permit operation at a higher stress level and the addition of material for balancing increased the thickness in the weld area greatly.

The two pass per side procedure failed to completely fill the groove in the thicker wheel; slowing down the travel speed to permit greater deposition of material filled the groove satisfactorily but resulted in center-bead cracking because of the configuration. Three weld passes per side were impractical with the $\frac{1}{16}$-inch diameter welding wire. The current had to be reduced to the extent that the metal transfer characteristics of the molten weld wire changed from a desired fine spray-like transfer to an undesirable globular transfer. The spray transfer enhances arc stability and uniformity of arcing, while erratic arcing with occasional shorting can be expected with globular type.

In order to maintain the proper current density and yet deposit a smaller weld, it was necessary to reduce the wire diameter to .045-inches. The groove design was unaltered from that already developed.

The three pass per side welding procedure employing .045-inch wire appeared satisfactory. Settings for wire feed were converted from those developed with .062-inch wire on the basis of maintaining the same current density.

Porosity: These procedures produced wheels which possessed satisfactory starts, were free of circumferential or center-bead cracking, and in which radial cracking was within the limits set. Throughout the investigation, however, considerable porosity had been observed in the weld. Porosity is caused by the entrapment of gas and is present to at least a minor extent in all welding. In the case of automatic welding of wheels, increased amounts of porosity were encountered since the travel speeds and solidification rates on this type of welding are such that gases do not have time to escape.

A study was made of the factors affecting porosity in automatic welding as part of the overall welded wheel program. One type of severe porosity was encountered in the first few inches of welding, but not on every specimen. This was traced to the introduction of water vapor in the inert gas stream because of condensation in the water-cooled nozzle during preheating with a gas torch, or on humid days. We overcame this by using a solenoid to restrict cooling water flow to welding periods only.

Scattered porosity throughout the weld could be reduced appreciably by increasing the inert gas flow during welding. However, excessive flow proved detrimental because of a siphoning effect, which introduced air. For the application, 70cfh of one percent oxygen-argon was most satisfactory.

The use of CO_2 was not pursued to any great extent because of the urgency of the program. This may be a worthwhile subject for future studies.

Contamination of welding wire was one of the major factors contributing to porosity. Pickling of the wire in a 10 percent solution of nitric-hydrofluoric acids, or vacuum annealing, to remove oxides and drawing compound residues reduced porosity to acceptable amounts.

Welding wire: A great deal of trouble was encountered in obtaining satisfactory welding wire. This trouble was eliminated and satisfactory wire was received when suppliers became aware of and agreed to the need for high level wire quality for fully automatic welding.

Welding procedures: The individual buckets are fixtured against the hub and held in proper alignment by locating from the foil section of each bucket.

Once fixtured, the entire assembly is preheated at 550°F to 700°F in order to retard the cooling rate after welding and prevent cracking of the hub material. For the same reason, a post-heat after welding at the same temperature for one hour is necessary.

Torch angle and nozzle height are extremely important in obtaining uniform gas coverage and welding location and configuration. The torch is centered vertically above the groove, at an 11° forehand angle. The root passes on each side of the wheel are deposited with the wheel positioned at a 25° angle in order to properly locate this weld bead, with the torch angle unchanged, and welding still carried out in the forehand position.

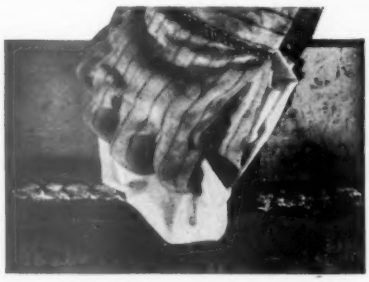
The final hub passes on each side are done in the same manner as the root beads. Weld sequence consists of depositing the root pass on the stub side of the hub. The shaft side is then machined to remove the metal used for back-up and to get ready for the second pass. This shaft side root pass is then deposited, followed by the bucket and hub pass on the same side. The buckets distort toward the first pass, and the three subsequent passes on the opposite side compensate for this movement. The final two passes on the hub side are then deposited, leav-

ing very little bucket run-out. Proper clearances in the fixture are needed to permit this movement, thereby preventing cracking and yet controlling bucket alignment.

The nozzle height affects the voltage drop in the wire extending from the contact tip to the work. For repetitive results, a consistent nozzle height is necessary, although the actual value is relatively unimportant.

A travel speed of 26 seconds per revolution is employed for the root and hub passes, while 18 seconds per revolution is used for the bucket pass in order to deposit a small weld and leave sufficient area for the final hub passes. When too large a bucket weld is deposited, lack of penetration can result.

It is extremely important that the surfaces of the root passes be as uniform as possible in order to properly deposit the remaining welds. If the surface of these root pass welds are excessively reinforced, or if skips exist between the weld and groove sidewalls, it is not possible to obtain complete weld penetration in later passes. Should either of these conditions occur, the entire root pass should be removed and rewelded with an adjusted setting. If the wheels are concentrically aligned prior to welding, no manual guidance nor adjustments are necessary during the welding cycle. • •



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A new process report . . .

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OF MILD-STEEL WELD METAL DEPOSITED WITH DIP-TRANSFER TECHNIQUE

100% CO_2

Yield Strength (psi)	Ultimate Strength (psi)	Elongation 2" gage (%)	Reduction of Area (%)
65,700	82,600	19	47

	C	Mn	Si	S	P
Weld Metal Composition	0.11	0.64	0.36	0.02	0.02
Electrode Composition	0.12	0.93	0.54	0.02	0.02

Dip Transfer CO_2 Welding Of Mild And Low Alloy Steels

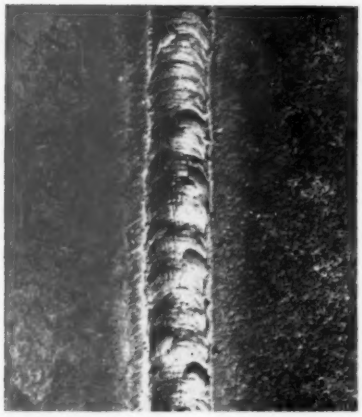
IN BRIEF: New process makes possible economical welding of mild and low alloy steels in all positions.

A NEW Dip Transfer process developed by Air Reduction Sales Co. is said to minimize, if not eliminate, the deficiencies associated with consumable electrode welding of mild and low alloy steels in a carbon dioxide shielding atmosphere. The process is said to permit economical welding in all positions. It does away with spatter and losses of critical elements within the electrodes. It also eliminates the difficulties caused by inherent high heat input to the work usually required to maintain proper arc length, including excessive penetration on thin sections and difficult-to-control weld pools.

With Dip Transfer, metal is transferred entirely by a wiping action at the time of short circuit, rather than being projected through an arc stream. The short circuits, caused by the electrode dipping into the weld pool, occur at a very steady rate, as high as 200 contacts per second. The result is a pulsing arc rather than an open, stable arc used in conventional techniques.

The pulsing arc occurs with a relatively low arc voltage and only with a power supply having a value of inductance that will properly regulate the rate of rise and decay of current.

The moving electrode comes in contact with the pool, creating a short circuit load on the power supply. This causes the current to surge upward toward a very high value. However, before this electrical surge reaches its maximum peak, overheating is caused



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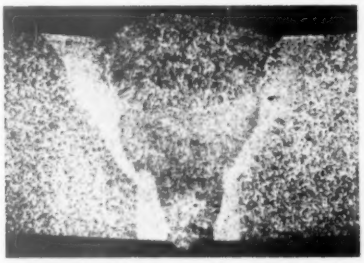
CROSS-SECTION: 2½X



VERTICAL BUTT WELD was made in ½-inch plate using a shield of 80 percent argon and 20 percent CO_2. Arc was oscillated across the joint to form wider deposit. Weaving was not needed to keep pool from running out.

by resistance to the flow of current at the point where the electrode enters the weld pool. Surface tension causes the metal to be wiped off the electrode and shortly thereafter—with an assist from electromagnetic pinch effect—the contact is broken and a relatively high current arc is established. This sequence results in metal transfer without spatter.

The energy from this arc melts the electrode and keeps the weld pool fluid. It comes in large part from energy stored in the electrical inductance during the interval of short circuiting. The dissipation of this energy is accomplished in an early stage by a transient arc voltage which is caused by the rapid breaking of an inductive power supply under static conditions. The arc develops considerable force which creates a depression in the weld pool.

As the energy from the inductor is discharged to the arc, three things happen: the voltage and

continued on page 56

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A threaded coupling holds head and barrel together, and permits the head to swivel freely. Loosen the coupling, even without removal from the machine, for inspection and maintenance.

Made in twelve models: barrels are 8" and 12" long, 1", 1¼" and 1½" diameter, and hold No. 1 and No. 2 Morse taper tips in threaded adapters, furnished as part of each holder. Adapters are RWMA class 2 alloy to reduce wear of the tip socket.

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DIP TRANSFER WELDING

continued from page 55

current decay, the forces on the weld pool decrease and the melting electrode advances toward the work. Therefore, arc length decreases. Finally, the electrode and the pool again come in contact, the liquid drop is transferred to the pool, and the cycle repeats itself.

The period of each cycle is very uniform. Under the most desirable conditions it will repeat itself between 100 and 200 times per second. The principle on which Dip Transfer hinges, this cycle is determined by the inductance of the circuit and the voltage setting of the power supply.

If the inductance of the circuit is too low, excessive spatter is generated and cold laps are formed at the edges of the weld. On the other hand, if the inductance is too high, large drops will form at the electrode tip which allows the arc to fluctuate, making it difficult to control and again increasing spatter losses.

Other factors enter into the determination of this uniform cycle: electrode wire diameter, the electrode extension (distance between the gun and arc) and the rate at which the electrode is fed into the arc.

The correct correlation of all these elements regulates weld quality. With correct correlations metal transfer is close to 95 percent, the molten pool will not sag nor run and it will be easy to maintain, with resultant spatter-free, strong-bonded welds.

The welding power source is of particular importance to Dip Transfer welding. Specifically, its inductance must be of the proper value. Constant voltage or rising voltage power supplies are required, and they must be designed with the correct amount of inductance.

Dip Transfer is most practical at current levels below 200 amperes. These currents are most compatible with fine diameter wires, preferably less than .045-inch. With fine wire and reduced energy input, the size of the weld pool remains small and is easily managed, making all-position welding practical. When wires larger than .045-inch are used

current levels are not sufficiently high to give stable metal transfer. The result is an arc difficult, if not impossible, for an operator to manipulate.

Feed problems with fine wires used were solved by the development of a welding gun which pulled wire through the casing with the drive rolls contained within the body of the gun itself.

Short extension results in higher frequency and less spatter loss — but even more important — with a short extension, a great range of electrode feed speed may be used without adjusting the power supply and more manipulation of the arc is possible while still maintaining good metal transfer.

In welding low alloy steel in a shield of 100 percent CO_2, oxidation of critical elements within the electrodes can be overcome by substituting a shield of argon and carbon dioxide for one of 100 percent carbon dioxide.

Dip Transfer is particularly well suited to welding sheet .253-inch and smaller. However, heavier sections can be welded easily since deposition rates as high as six pounds per hour have been achieved in the vertical position using small diameter wires with the average currents approaching 200 amperes. It is especially effective in this type of vertical welding of heavy plate and also overhead welding.

Little operator skill is required. Virtually no training is needed for an operator to produce sound, well-formed and spatter-free welds. • •

Arcos Distributes Vertomatic Machine

PHILADELPHIA, PENNA.: Exclusive distribution rights in the United States for the newly-developed Vertomatic Welding Machine for the electro-slag welding process have been obtained by Arcos Corporation.

According to Arcos officials, the most important feature of this new process is the superior weld quality obtained as compared to conventional multi-pass welds. High quality butt welds up to 20-inches thick can be made in one pass with the Vertomatic equipment.

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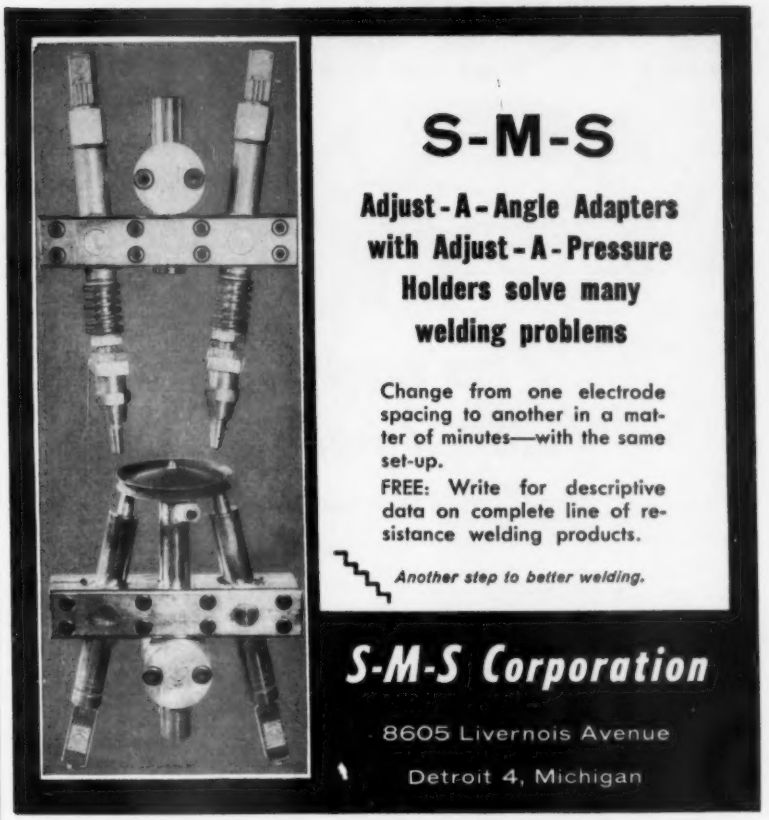
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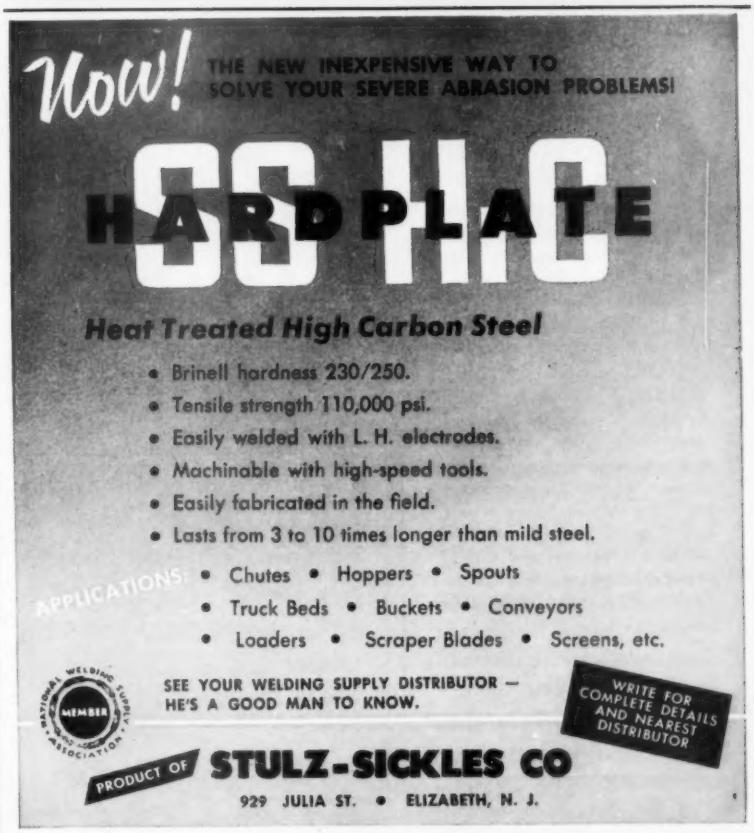
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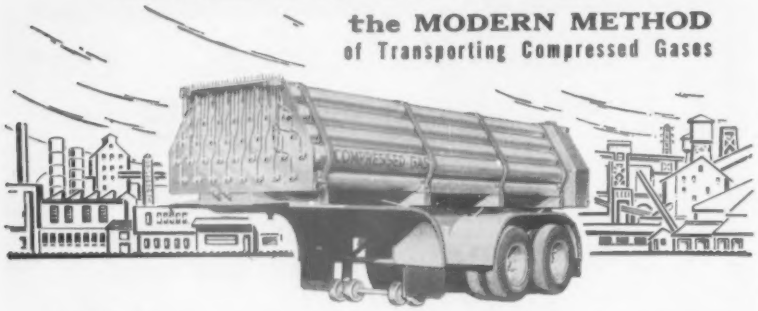

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The Foundation is located on the campus of the Illinois Institute of Technology and encourages graduate engineering study through its education program providing tuition free graduate study, in addition to offering competitive salaries and liberal benefits including generous relocation allowance and vacation program.

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NEWS OF THE INDUSTRY

continued from page 50

Cleveland Company Now Part of Air Products, Inc.

ALLENTOWN, PENNA.: Compressed Gases of Ohio, Inc., Cleveland, Ohio, has become a unit of Air Products, Inc. Air Products has placed their full facility behind the operation, distribution and marketing of high purity industrial and medical gases in the Cleveland marketing area under the name of Compressed Gases of Ohio, Inc. In addition, a complete line of electric and gas welding and cutting equipment and supplies will continue to be distributed in the Cleveland area.

R. William Metzger, former president of Compressed Gases of Ohio, Inc., will serve as district manager.

Resistance Welding Films Are Available

PHILADELPHIA, PENNA.: The Resistance Welder Manufacturers' Association has available three 16 mm. color films which may be borrowed without charge.

The first two are in sound. "This Is Resistance Welding" describes the fundamentals of the resistance welding processes. It runs 20 minutes. "Resistance Welding" is a 23-minute sequel which further describes these processes.

"Resistance Welding of Stainless Steel" is 21 minute film.

Requests should be sent to the R.W.M.A. at 1900 Arch St., Philadelphia 3, Pa.

Forms Engineering Company In New Jersey

PLAINFIELD, N.J.: Because Alloy Fabricators Division of Continental Copper & Steel Industries, Perth Amboy, N.J., has discontinued the manufacture of chemical process equipment, A. Grodner, chief engineer, has organized his own engineering company at 1122 Park Ave., Plainfield, N.J., for the design and manufacture of such equipment.

Linde Gas Plant Is Ahead Of Schedule

PITTSBURG, CALIFORNIA: A multi-million dollar oxygen-nitrogen producing plant built here by Linde Company, Division of Union Carbide Corp., was completed ahead of schedule. The first section of the plant, with a production capacity of 115 million cubic feet of liquid oxygen and nitrogen a month, went into production ahead of the original target date of June 1.

Airco Completes New Denver Plant

DENVER, COLORADO: Announcement has been made by Air Reduction Sales Co. of the completion of a new oxygen and nitrogen plant here. It is the first major gas-producing installation built in the general area by Air Reduction.

NCG Completes LA Liquid Oxygen Plant

LOS ANGELES, CALIF.: A $1,750,000 plant producing more than 35 tons of liquid oxygen, nitrogen and argon each day has been placed on stream here by the National Cylinder Gas Division of Chemetron Corp.

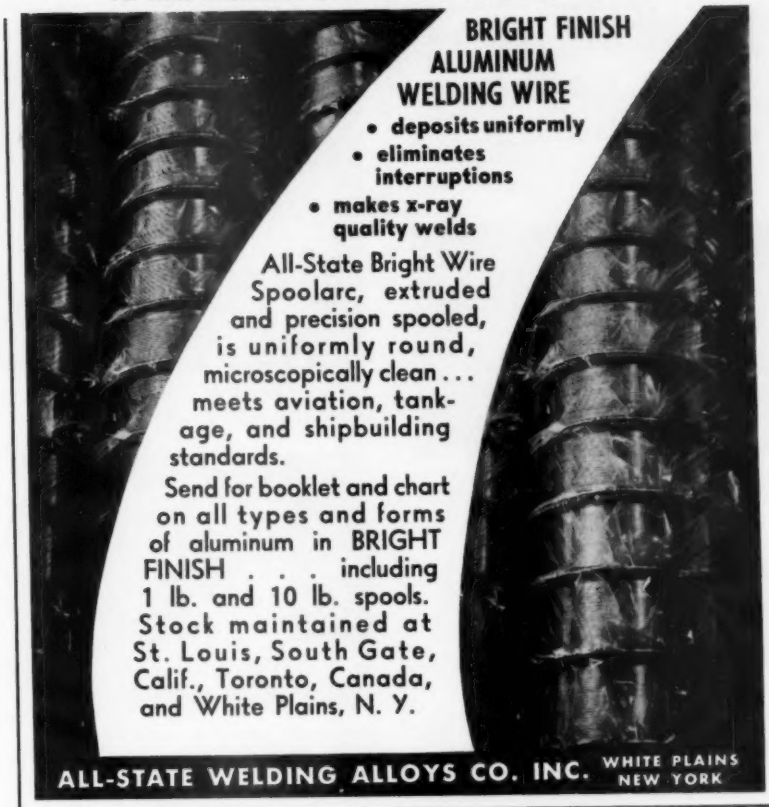
New Thermit Welding Company

LAKEHURST, N. J.: After a year and a half of operation as a division of Reade Mfg., Thermex Metallurgical, Inc., will now carry on, as a separate corporation, the Thermit welding business acquired by Reade from Metal & Thermit Corp., in 1957.

NCG Headquarters Opened In Dallas

DALLAS, TEXAS: Establishment of a new Southwestern regional headquarters at 519 Brannif Airways Building has been announced by the National Cylinder Gas Division of Chemetron Corp. The office was formerly at 3301 S. National Street.

For More Information Circle No. 4 on Reader Service Card.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RUEMELIN Portable Fume Collector

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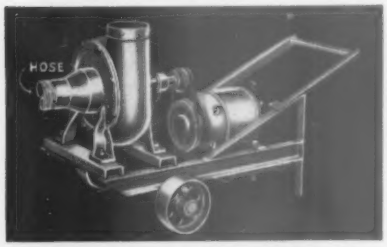

• Collector is equipped with a power unit capable of handling up to 35 ft. of steel tubing. Mounted on rubber tired wheels for ease of handling. Models also available mounted on steel legs for hose operation in a complete 360 degree circle.

• This view shows inlet hood picking up welding smoke. Operator breathing zone protected.

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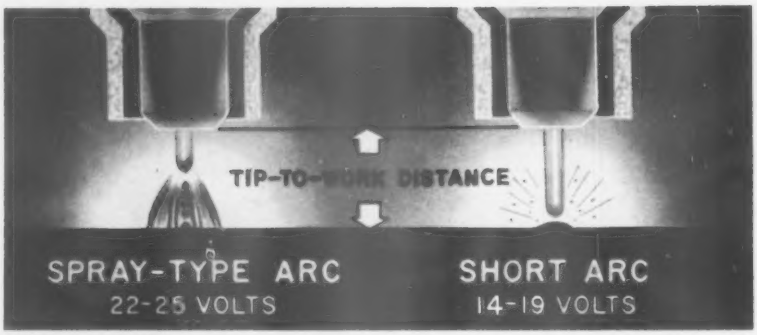
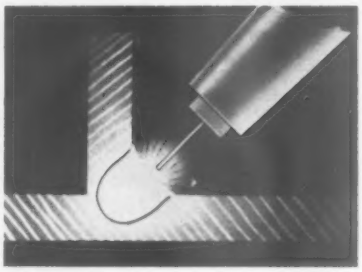
A new process report . . .



METAL TRANSFER under normal arc conditions (left) is contrasted with "Short-Arc" operation (right).



PINPOINT CONTROL of arc heat permits welding of thin materials in any position.

SIXTEEN-GAUGE carbon steel is welded at 18 ipm in the overhead position.

"Short-Arc" Welding Of Thin Materials

IN BRIEF: New inert-gas consumable electrode process permits manual and mechanized welding of thin material.

A NEW WELDING PROCESS, called "Short-Arc", welding has been developed by Linde Company, Division of Union Carbide Corporation. It is said to permit manual and mechanized welding of thin material with excellent control of the weld puddle. The outstanding feature of this new inert-gas consumable-electrode process is the ability to make manual fusion welds in the range of thickness of .030 to .100-inch of all common metals, such as carbon steel, stainless steel, aluminum (.040 inch minimum), copper, etc., in all positions and types of joints.

The "Short-Arc" process exhibits inherent advantages over other welding methods for welding sheet metal Linde reports. The process provides a more-readily-controllable welding process at high welding speeds, easier production of fillet welds, ability to weld in all positions, and — of significant importance — the ability to weld sheet metal in a range of thicknesses heretofore not considered readily weldable by any process.

Successful operation of the process depended on the development of several key factors: proper power source, selection of shielding gas, and apparatus for feeding small diameter wires.

Power supply: Normal fusion welding operations using conventional type power supplies with either covered electrodes or inert-gas shielded processes, give too much heat and cause uncontrolled melting when making butt, lap, or fillet welds in thin gauge material. The Linde "Short-Arc" process has been made possible by the use of constant potential power supplies a drooping characteristic.

With the development of this new type of power supply it was found that surge currents could be controlled to limit the time

duration of arc outages, prevent wire ejection, and produce a stable buzzing type of arc. This arc, operating in the range of 30 to 125 amp., 14 to 19 volts, short circuits dozens of times per second. This produces a small cold puddle pinpointing the location of the arc heat and enabling the welding of thin materials in all positions. It is used primarily with .030-inch diameter wire, although .020-inch diameter hard wire works well on material in the very low end of the thickness range.

Shielding gas: Considerable study has been given to evaluating shielding gases and mixtures and selecting the best in each instance. Argon has been found suitable for most metals such as aluminum, copper, and Everdur. For stainless steel and carbon steel, argon-oxygen and argon-carbon dioxide mixtures are finding wide acceptance. Pure carbon dioxide is being used for some steel applications, but it produces somewhat more spatter and poorer bead formation. The use of argon-carbon dioxide mixtures provides many advantages over either argon or straight carbon dioxide on carbon steel. Their use provides superior wetting action with the minimum amount of deposited metal resulting in a vastly improved bead contour. An approved mixture is now commercially available.

A key factor in the success of "Short-Arc" welding was the development of both manual and mechanized equipment to feed wires as small as .020- or .030-inch diameter.

The process is easy to use. Very little training is required for adaptable personnel. Manual welds can be made readily in all positions on most commercial light-gauge materials.

The Linde "Short-Arc" process makes high quality welds quickly and economically in carbon steel, stainless, aluminum and other metals. Distortion is minimized due to the pinpoint-type arc and there is little or no post-weld cleaning. Joints with poor fit-up are easily accommodated with manual welding. For example, the company reports ¼-inch gaps on 14-gage carbon steel have been bridged with ease. • •

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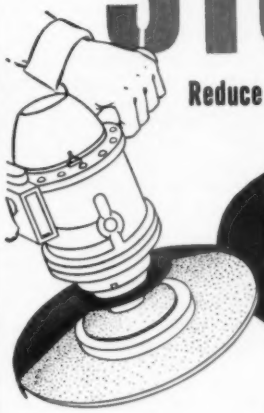

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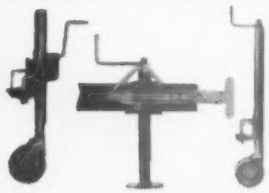

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REFERENCE DATA

catalogs, handbooks, manuals

SPOT AND BUTT WELDER CATALOG (No. 93-57) consisting of 16-pages of illustrations and descriptions is available from Eisler Engineering Co., Inc. Over a hundred welders shown can be used for small part, wire, sheet metal, and foil welding. Special resistance welding setups, tweezer and small gun welders are also covered. **For More Information Circle No. 82 on Reader Service Card.**

"BITING EDGE" DISCS are the subject of literature from Abrasives Company of America, which describes how Magnecoating provides longer disc life, greater particle density and more cutting edges per square inch. Particles are described as being positioned vertically by magnetism; when tops break, fresh biting edges are provided. Five disc-types covering every normal use are described. Available grit sizes are given for each. **For More Information Circle No. 7 on Reader Service Card.**

BILLED AS HEAT TREATING'S MOST VERSATILE TOOL is the Smith-Dolan System of low-frequency induction heating described in a colorful brochure by the manufacturer, Electric Arc, Inc. Said to be ideal for preheating, stress-relieving and heat treating in shop or field, units come in four AC models—rated from 10- to 150-KVA—and one 400 cycle motor-generated model. **For More Information Circle No. 83 on Reader Service Card.**

WELDING WIRES for submerged arc and inert gas welding are the subject of the revised and expanded 6-page Bulletin DH-402-C prepared by Page Steel and Wire Division, American Chain & Cable Co., Inc. Featured are the uses of 26 analyses, including stainless steel, low alloy, and mild steel. Guide tells the user what to expect from each analysis and describes the various methods of packaging the wire. **For More Information Circle No. 84 on Reader Service Card.**

COATED FABRIC GLOVES, comprising 6 complete lines, are described in 4-page, punched-hole bulletin available from American Optical Company. Lines feature improved adhesion of neoprene to fabric; better abrasive resistance; better snag resistance; curved fingers—less hand fatigue; uniform coatings; and longer wear. A chemical resistance reference chart is included. **For More Information Circle No. 85 on Reader Service Card.**

PORTABLE WELDING SHIELD made of UL-approved fire-resistant fabric is featured in a bulletin from Frommelt Industries. Spa-Fla shield stands alone because of its welded wire insert, has rings for overhead suspension and can be used with ring stands for inside job ventilation or outside job wind break. Literature illustrates how lightweight shield can be rolled, carried, moved or shaped. **For More Information Circle No. 86 on Reader Service Card.**

HOW YOU CAN CONVERT any automatic oxyacetylene cutting unit into a fully automatic Tig welder is explained in literature from Tec Torch Co., Inc., which features new Model 4550 Tec Machine Torch. Literature explains how durable, one-piece construction eliminates replacement parts, leaks, and how transparent gas nozzle gives full view of the weld. **For More Information Circle No. 87 on Reader Service Card.**

HOW TO GRIND AND FINISH with one raised-hub disc-wheel is explained in a notebook sheet available from Bay State Abrasive Products Company. Copy tells how the two-layer construction, each layer of which resists loading, does the job—with a 30- to 45-degree angle for grinding, a 10- to 20-degree angle for finishing. Also included, are the wheel grit specs for the 7-inch, ¼- or 3/12-inch thick wheels. **For More Information Circle No. 88 on Reader Service Card.**

400 MODELS of American Manganese Steel Division's tooth point and tooth adapter models for every make of shovel, dipper and backhoe are listed in a 16-page catalog available from that company. Featured item is the new "Simplex" two-part reversible point dipper tooth which is said to last as much as 4-times longer than other makes. **For More Information Circle No. 89 on Reader Service Card.**

For More Information Circle No. 27 on Reader Service Card.→

FIRST programmed automation for inert gas welding!

FIRST tape-controlled programming!

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Columbia Electric Mfg. Co.

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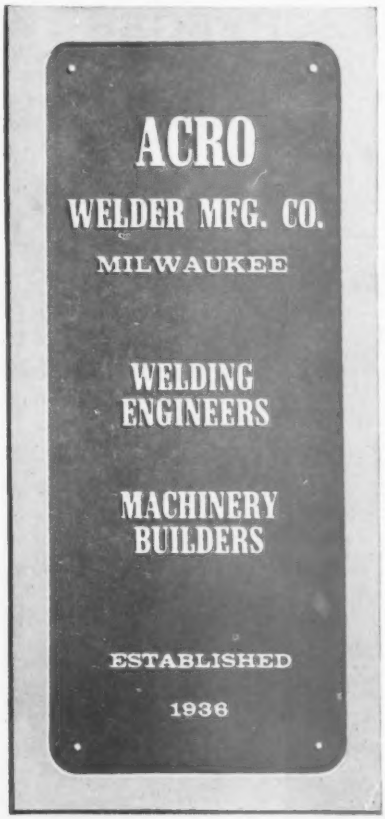

Circle No. 2 on Reader Service Card.

USEFUL LITERATURE *continued*

THE ADVANTAGES OF HAND TORCH BRAZING with silver alloys are outlined in Handy & Harman's Brazing News (#81, Hand Torch Edition) just off the press. Five illustrated case histories included can serve as idea starters. Five rules are given for proper use of a torch; chart gives maximum temperatures to expect with various gas combinations.
Circle No. 90 on Reader Service Card.

TORCHES AND TUNGSTEN ELECTRODES for inert gas arc welding are the subject of a 16-page catalog (VA 58) available from the K-G Equipment Company. Specifications and parts lists are given for 6 torch-types designed for light, heavy and special applications. Sizes, lengths and current-carrying capacities are given for pure tungsten, 1% thoriated tungsten, and 2% thoriated tungsten electrodes.
Circle No. 33 on Reader Service Card.

PROXIMITY POSITIONING CONTROL made by Square D Company is the subject of a single sheet bulletin that describes the control and its use with automatic arc welding and metal flame cutting machines. This control senses and adjusts for surface irregularities. It can only be used where work is a ferrous material.
Circle No. 91 on Reader Service Card.

FLOW CONTROL EQUIPMENT is the subject of a new 12-page catalog describing Air Reduction Sales Company's line of gas flow control equipment for argon, helium and CO^2. It covers Airco's new series of fixed-pressure regulators with flow adapters. Also given are details on Airco's demand-type proportioner for customers requiring special gas mixtures for pipe line distribution systems.
Circle No. 92 on Reader Service Card.

WEAR-RESISTANT ELECTRODES for industry are featured in new bulletin W-17 from Ampco Metal, Inc. Deposit and application characteristics are given for four Ampco-Trode overlay electrodes.
Circle No. 93 on Reader Service Card.

A NEW WIRE FEEDER for semi-and full automatic welding is described in a brochure issued by Metal & Thermit Corporation. The "Murematic" wire feeder is a highly versatile unit for open arc, submerged arc, or CO^2 gas shielded arc welding.
Circle No. 94 on Reader Service Card.

RADIATION IN INDUSTRY is the subject of a 12-page booklet published by Picker X-Ray Corporation on the use of X-rays and gamma rays for nondestructive inspection and product testing. The illustrated booklet considers the advantages and disadvantages of both radiation sources for inspection purposes and answers questions most frequently asked about each.
Circle No. 95 on Reader Service Card.

METALLIC ZINC COATING that is described and illustrated in 2-color bulletin just released by American Solder & Flux Company. One gallon of Drygalv is said to protect 400 square feet of surface and provide complete cathodic protection even against salt water. This 95% metallic film is either applied by brush or spray. It stops rust and corrosion on ferrous metals and welded joints.
Circle No. 96 on Reader Service Card.

A NEW CAST NICKEL-BASE ALLOY that offers outstanding resistance to corrosion from sulphuric acid at all concentrations and temperatures, while maintaining high strength, is covered in a newly-printed folder issued by Haynes Stellite Company, Division of Union Carbide Corporation. Physical, chemical and mechanical properties of "Hastelloy" alloy D are presented.
Circle No. 97 on Reader Service Card.

NEW SEMI-AUTOMATIC WELDING SYSTEM made by The Reid-Avery Company, Inc., is featured in a comprehensive 6-page Bulletin RD-400. Brochure gives cost comparisons and direct savings of new "Dynaweld System" over the stick electrode welding. Characteristics and illustrations of typical welds are given.
Circle No. 98 on Reader Service Card.

AIR AND ELECTRIC POWERED NIBBLERS made by Fenway Machine Company, Inc. are the subject of a 4-page folder. Design details and operating specifications are given for a complete line for cutting light to heavy gauge materials, including corrugated steel.
Circle No. 24 on Reader Service Card.

NEW ALLOY that combines the advantages of excellent resistance to corrosion with good strength at high temperatures is the subject of a new 12-page booklet offered by Haynes Stellite Company, Division of Union Carbide Corporation. "Hastelloy" alloy B was developed to offer chemical processors excellent resistance to hydrochloric acid over a wide range of concentrations and temperatures. It retains over two-thirds of its

room temperature yield strength at 1600 deg. F.
Circle No. 99 on Reader Service Card.

KICKLESS RESISTANCE WELDING CABLE made by Uniflex Cable Division, Gar Wood Industries Inc., is the subject of Bulletin UM-115. Described and illustrated is Super-Life Model "B" cable. Also featured are listings and illustrations of available model B cable terminal combinations.
Circle No. 100 on Reader Service Card.

PORTABLE CUTTING MACHINES are the subject illustrated and described in an 8-page punched-hole folder offered by Indiana Oxygen Company. Folder gives information on cutting straight lines, circles and arcs. It also illustrates multiple torch operations using portable equipment.
Circle No. 101 on Reader Service Card.

IDEALARC "TM" ARC WELDERS for AC and AC/DC welding are the subject of a 4-page catalog issued by Lincoln Electric Co. Complete operating details and specifications are given for this transformer-type machine with a moveable-core reactor current control.
Circle No. 102 on Reader Service Card.

TEMPERATURE-INDICATING PIGMENTS developed by Curtiss-Wright Corporation are featured in a 2-page brochure, a brand survey sheet, and a 5-page pocket folder. Each gives description and characteristics of "Thermocolor" pigments and "Thermochrome" crayons.
Circle No. 103 on Readers Service Card.

NEW INDUSTRIAL X-RAY CATALOG describes the Baltograph Panoram-X industrial X-ray unit manufactured by the Balteau Electric Corporation. Complete specifications are included, along with photographs showing typical uses and suggested applications.
Circle No. 104 on Reader Service Card.

FREE FLUX SAMPLES are available from Krembs & Company, manufacturer of 25 different welding, brazing and soldering fluxes. Write for yours on company letterhead. Use Reader Service Card for literature.
Circle No. 34 on Reader Service Card.

SOLDERING TIPS are the subject in a new catalog offered by Hexacon Electric Co. The new catalog shows 81 new shapes and sizes—a total of 124. The catalog gives complete dimensions and advice on use and care.
Circle No. 107 on Reader Service Card.

Circle No. 61 on Reader Service Card.

THE NEWEST PORTABLE SPOT WELDER

Merit Might Midget

Completely new . . . and engineered for today's production demands . . . the Merit Might Midget is the perfect answer to all your welding problems.

- Trouble-free electronic timer and contactor
- Welds up to 3/16" combined thickness
- Uses standard #1 Morse taper tips
- Variable tip pressure—0 to 1000 lbs. in seconds
- Available in 2 models; Water-cooled or Air-cooled

For additional information, ask your jobber or write: The Merit Company, 2124 W. Chicago Ave., Chicago 22, Ill.

Sold through jobbers only
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THE MERIT COMPANY
2124 W. Chicago Avenue
Chicago 22, Illinois

IPM
direct reading

WELDING SPEED GAUGE

Fast • simple • accurate
Invaluable to welding engineers and all others interested in welding speed factors. No figuring . . . no fussing . . . no mathematical calculations required. Eliminates errors—attractively priced.

CECIL C. PECK COMPANY
14901 Woodworth Rd., Cleveland 12, Ohio

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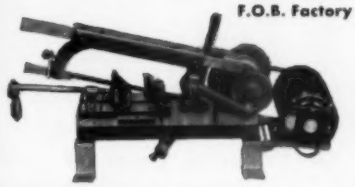
A Rugged . . . Versatile
POWER HACKSAW
COMPLETE ONLY **$790.00**
F.O.B. Factory



JEFFERSON "601"
Complete with motor and switch, wired, ready-to-go.

SAWS . . . bar, round, angle or pipe up to 4" x 4".

RUGGED . . Cast base, heavier guide bar support arms and guide bar with adjustable bronze wear plate and Oilite bearings throughout.

FEATURES include fast acting 45° swivel vise, pressure relief on back stroke, length gauge bar, motor mount and ¼ h.p. motor. Built by builders of power hacksaws for industry since 1931.

Order from your Welding Equipment Dealer or write direct for details or prompt shipment.

KELLER DIV.
Sales Service Mfg. Co.
2365 University Ave., St. Paul 14N, Minn.

Circle No. 46 on Reader Service Card.

NEW PRODUCTS

New Ignitron Tube

A new size E control ignitron tube for A-C control service has been announced by General Electric's Power Tube Department. Designated GL-7151, the new tube features a stainless steel jacket with more efficient water channel cooling and a mounting braket for a detachable thermos-

The size E ignitron is designed to meet the demands of high-current applications, such as resistance welders and direct-drive stamping presses.

Circle No. 115 on Reader Service Card.

Punched Tape Control Of Welding Program

Programming a weld to control the time and magnitude of welding current is here effected by using a punched tape and reader device incorporating control relays and resistors which are switched in combinations as set up on the tape. Developer is Harnischfeger Corp.

The fine steps in control current which are available from a few coarse steps of resistance result from the binary arrangement of ohmic values in series with the excitation coils of a saturable reactor. By selecting resistors with ½, 1, 2, 4, 8 ohms, it is possible to get a variation of total ohms from ½-ohm to 15½-ohms in ½-ohm steps. Thus, five relays and these resistors can be programmed to give the same accuracy of current adjustment as is available with a 15½-ohm rheostat.

The device consists of a punched tape and reader, five resistors, several relays, and the necessary control buttons and switches.

To program a weld, it is necessary to establish in advance the current vs time curve desired.

The current variation is a function of ohms in series with the exciter circuit and the position of the current limiting panel rheostat. A tabulation of amperes vs. punched hole configuration vs. setting of the current limiting rheostat permits punching holes to give the ordinate values for each value of time.

The reader then translates the holes into resistor combinations to vary the saturation in the saturable reactor and give a current plot.

Circle No. 116 on Reader Service Card.

Portable 200 Amp Welder

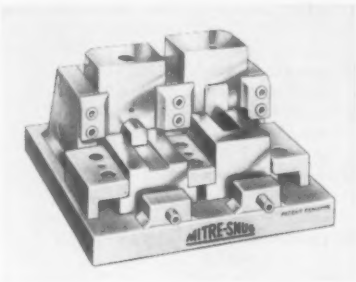
The Mor-Amp Welding Company has developed a 95 lb. welder that measures only 16- by 11- by 18-inches, but that will give big industrial welder performance. Unit operates on 220 volts, 60 cycle single phase, is fan-cooled and features heavy duty transformer, plugs and connectors and extra-heavy No. 2 welding cable. Model 200C is rated at 75% efficiency at 50% duty cycle.

Circle No. 117 on Reader Service Card.

Low Hydrogen Nickel-Manganese Electrode

A new low hydrogen nickel manganese, AC-DC electrode, designated No. HS-4, AC-DC, has been announced by All-State Welding Alloys Co., Inc. The electrode is recommended for use on austenitic manganese and carbon steels as a substitute for more costly stainless electrodes. Strength, ductility and impact strength of deposit are said to be superior to austenitic manganese or stainless steel deposits. Worked welds will harden to 50 Rockwell C. Electrode is said to be easy to use, making it effective for reclamation work.

Circle No. 118 on Reader Service Card.



Easy Mitres For Tubing

The Mitre-Snug introduced by Vogel Tool & Die Corp. combines two operations in one, providing a fast, easy and cheap means to mitre both round and square tubing including preformed shapes. The unit produces close-fitting, true-mitre joints that can be brazed or induction welded without the need for filing or deburring.

The Mitre-Snug is precision built to afford maximum cutting life and to provide for the interchangeability of punches and dies of various sizes and cutting angles.

Circle No. 119 on Reader Service Card.

New Rain Hood

A flexible rain hood made of virgin vinyl for low temperature flexibility is being manufactured by Fibre-Metal Products Co. New Rain Hood R-1 is quickly and easily installed in Fibre-Metal's complete line of Fiberglas and aluminum hats and caps. There are only four points of attachment to the headband and three plastic fasteners at its front.

The hood prevents rain from dripping down the back of the wearer's neck; there is full 360° ventilation under the crown and through and around the hat or cap suspension.

Circle No. 120 on Reader Service Card.

Aluminized Asbestos On Portable Floor Screen

Frommelt Industries announces the new Frommelt Porto-Screens available with Ray-Foil, the new UL-Approved protective heat curtain of aluminized asbestos cloth which gives assured protection against fire and high radiant heat.

Easily transported Porto-Screens come in three, four, or more sections. They serve as effective wind breakers, or room dividers and partitions. The four section screen easily forms around a job and its floor-hugging curtain makes it ideal for welding use.

Porto-Screens are available in five and six-foot heights and a variety of widths.

Circle No. 121 on Reader Service Card.

miller WELDERS

FIVE IN ONE

Fireball

Here's what makes this Miller model the "Five-in-One":

1. AC welder for metallic arc welding
2. DC welder for metallic arc welding
3. AC or DC welder for TIG welding
4. A 10 KW, 115/230v single phase 60 cycle power plant
5. 1 KW of DC while welding

The DAH-350-L Fireball, driven by Hercules 32 hp engine, is another Miller FIRST, offers both a-c and d-c for metallic arc or TIG welding with three separate a-c and d-c amperage ranges for each.

There's continuous high frequency for a-c TIG welding with choice of "start only" or constant high frequency for d-c TIG work.

Standard equipment includes built-in high frequency stabilizer, polarity switch, power supply for water coolant system, and automatic inert gas control panel with solenoid valve and post flow timer. Trailers are available for welder only or for welder with coolant system and gas cylinders.

SPECIFICATIONS

	Metallic Arc	Tungsten Arc
WELDING RANGE	35-100 Amps AC	35- 75 Amps AC
	65-160 Amps AC	65-160 Amps AC
	110-400 Amps AC	150-375 Amps AC
	35- 80 Amps DC	35-100 Amps DC
	75-175 Amps DC	85-225 Amps DC
	125-350 Amps DC	170-375 Amps DC
RATED OUTPUT	250 Amps Tungsten Arc, 100% Duty Cycle DC	
	300 Amps Tungsten Arc, 100% Duty Cycle AC	
CURRENT ADJUSTMENT STEPS	Infinite	
MAXIMUM O.C.V.	72 Volts DC	
	80 Volts AC	
1 KW DC AUXILIARY POWER	115 Volts	
AC GENERATOR OUTPUT	10 KW	
OUTPUT VOLTAGE	115/230 Volt, 1 Phase, 60 Cycle	

Complete specifications on these welders will be sent promptly upon request.

Other Miller welders in this series include:

DA-300-L BIG RIG
Four-in-One:
AC arc welder; DC arc welder; 10 KW AC power plant; 1 KW DC while welding

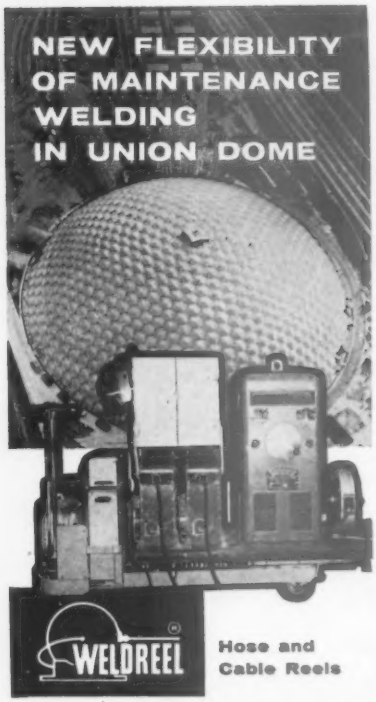
D-250-L ROUSTABOUT
Three-in-One:
DC arc welder; 10 KW AC power plant; 1 KW DC while welding

D-250-W ROUGHNECK
Two-in-One:
DC arc welder; 1 KW DC while welding

miller Electric Manufacturing Company, Inc., APPLETON, WISCONSIN

EXPORT OFFICE: 250 West 57th St., New York 19, N.Y. • Distributed in Canada by Canadian Liquid Air Co., Ltd., Montreal

For More Information Circle No. 39 on Reader Service Card.



WELDREEL® Hose and Cable Reels

AT UNION TANK CAR COMPANY'S new maintenance facility in Baton Rouge, Louisiana, portable welding units like this one, are easily moved right up to the job site by small lift truck. Then welding cable, ground cable and welding hose are paid out as needed from WELDREEL reels.

When a job is completed, hose and cable are quickly rewound onto reels by strong springs, and the entire unit moved to a new location. Not only does this permit maximum use of welding equipment . . . *it also extends life of hose and cable* . . . keeps it off floor when not in use . . . *increases plant safety.*

Designed to handle a wide variety of single and dual hose, and single and multiple cables, WELDREEL reels are available to a wide variety of industrial applications. Write for full information.

MODEL OA-A holds 50' of 3/16" or 40' of ¼" dual hose. Model OAB has capacity for 150' of ¼" or 125' of 5/16" hose.

MODEL EA-2 with current capacity of 300 amps holds 50' of 2/0 welding cable. Model EA has capacity of 100' cable.

MODEL A-1 has 50' capacity of ¼" or ⅜" I.D. single hose. The larger Model A-2 holds 50' of ½" hose.

UNITED SPECIALTIES INC.
POST OFFICE BOX 698 EL DORADO, ARKANSAS

Circle No. 54 on Reader Service Card.

New Weld Shaver

A new weld shaver developed by Zephyr Manufacturing Co. is said to remove and finish weld beads in one operation. The weld shaver utilizes a rotary cutter to remove excess filler and shave weld beads to surface plane. The cutter is mounted between adjustable rollers which straddle and follow the weld bead on flat, convex or concave surfaces.

Two models are available. ZT508 weld shaver is used on stainless, steel and titanium welds, geared to operate at 3,000 rpm. It is 11½ inches long and weighs 9½ lbs. Model ZT509 weld shaver is used on aluminum, copper, brass and magnesium welds, operates at 11,500 rpm. It is 9½ inches long and weighs 7½ lbs.

Circle No. 122 on Reader Service Card.

Safety Hats and Caps

An entirely new line of fibre-glass, aluminum and electrical (plastic) safety hats and caps has been developed by Apex Safety Products, Cleveland, Ohio, and will be marketed by Boyer-Campbell, well known safety equipment distributor.

The new safety headgear has been developed for all industrial, mill and mining applications and features a unique, new polyethylene suspension which the manufacturer says provides the "ultimate in hard hat safety." The suspension includes lock-straps at the peak which assure minimum 1½-inch clearance between crown and hat shell, and yet maintains adjustment provisions for comfortable crown depth fit.

Circle No. 123 on Reader Service Card.

Low Melting Silver-Bearing Alloy

A new silver-bearing brazing-type alloy providing lower melting temperature, higher fluidity and highest electrical conductivity is announced by the Eutectic Welding Alloys Corp.

EutecRod 1801-Super has exceptional wetting and thin flowing properties. It flows freely through long laps and complicated contours of copper, brass, bronze, steel and stainless steel, or dissimilar combinations. Due to the controlled plastic range of the alloy, user gets greater versatility on lap, flange, tee and butt joints.

The alloy melts at 1135°F, gives joints of up to 80,000 psi tensile strength that are highly resistant to corrosion and very high in electrical conductivity.

Circle No. 124 on Reader Service Card.

Compact Brazing And Soldering Set

The Kwik-Kit containing a complete assortment of materials for hard and soft soldering work is a new product of Special Chemicals Corporation.

Designed for the maintenance man and service industries, Kwik-Kit offers all materials for many emergency repair and upkeep jobs. Most ferrous and non-ferrous metals may be joined with the silver brazing alloy and soft solder in the kit. It is not suitable for joining aluminum, magnesium and titanium. Fluxes for both soft and silver solder are in easy-to-use unbreakable squeeze bottles.

Circle No. 125 on Reader Service Card.

Water-Saving Control

A control that cuts resistance welding costs by metering water only as it is needed is being marketed by Van Vooren Products. Called Water Mizer, control is a short proportioning time delay which operates in conjunction with one or more thermostats and can be used with a single solenoid valve or the HI-LO manifold. Model ES-10 control has a ½-inch solenoid valve and a surface mounting thermostat.

Circle No. 126 on Reader Service Card.

Light-Wall Stainless Fittings

Swivel-type flange and long tangents are featured in new line of "Pipe-Mate" light-wall stainless steel fittings and flanges introduced by Tube Turns Division of Chemetron Corporation for nominal-temperature, low-pressure non-critical process piping. Two-inch pipe shown here was expanded into stainless steel insert; then carbon steel flange portion can be rotated about the insert for easy alignment of bolt holes.

Pipe-Mate fittings, broadening Tube Turns' light wall stainless steel line, come in sizes ½" through 4", Schedule 5S and 10S. Besides flanging, fittings can be butt welded (as seen at other end of 90-degree elbow pictured), or fillet welded or brazed with use of aligning connector.

Circle No. 127 on Reader Service Card.

Raised Hub Disc-Wheel Grinds And Finishes

Specially designed to speed weld grinding and finishing operations, a new raised-hub disc-wheel for portable grinders has been developed by Bay State Abrasive Products Co.

The wheel's two-layer construction permits two grinding angles: When held 30 to 45-degrees to the work, it exposes the coarser-grained layer for fast metal removal. Held at a 10- to 20-degree angle, the wheel's second layer provides a smooth finish.

The coarse layer comes in one standard grit; the finishing layer is available in five grits, for finishing heavy steels through light stainless to aluminum and copper.

Circle No. 128 on Reader Service Card.

New Hose Reel

A new hand-operated reel with a capacity of 150' of ¼" dual hose has been put into production by United Specialities, Inc. The new Model OA-10 is not spring-operated but has a hand crank for reeling the hose. It features welded tubular construction.

An adjustable drag brake permits control of hose when paying out; sprocket and chain drive give extra power to the crank when reeling in; and positive locking pin prevents paying out of hose except when needed. Frame and reel are finished in baked-on enamel.

Circle No. 129 on Reader Service Card.

Rebuilding Tractor Rollers

Two new products of Sight Feed Generator Co., called the "Rexarc Twins", are said to revolutionize tractor roller rebuilding.

The Model MS-8 dual head automatic roller rebuilder features power-operated controls throughout, hydraulic and electric. Company officials claim one operator can do as much welding on this machine as three or four operators can do using single spindle machines.

The new Rexarc automatic flux circulating system requires no manual handling of flux in keeping flux hoppers filled. The operator needs only to empty a bag of flux periodically onto the vibrating screen. The rest is automatic.

Circle No. 130 on Reader Service Card.

Resistance Welding Instrumentation, Control

Recently introduced by Control Devices, Inc. are current and potential transformers and a cable testing device for analyzing and servicing resistance welders. The transformers are used with direct-writing oscillographs to measure primary voltage and current and for cycle counting. They can also be used for adjusting controls for up and down slopes.

The self-contained, lightweight, cable testing device gives percentage of conductivity of welding cable —in various lengths and crossections.

Circle No. 131 on Reader Service Card.

Threaded Connection

A new threaded power connection for use with the company's Hi-Amp electrode holders has been announced by Lenco, Inc. Purpose is to provide positive connection and to lengthen cable life by eliminating cable-flexing at holder. Connector is quickly applied by three-step procedure: Trim insulation; slip on threaded sleeve; and crimp with Swedg-on tool.

Circle No. 132 on Reader Service Card.

Brazing Stop-Off

A new easy-to-remove stop-off material for control of brazing alloy flow during furnace processing is now available from Stainless Processing Division, Wall Colmony Corporation.

Called Nicrobraz Red Stop-Off, the new material is applicable to furnace brazing only. This liquid acts as a barrier to molten brazing alloys by preventing the capillary action needed for proper flow. It prevents flow on any metal surface to which it is applied.

Circle No. 133 on Reader Service Card.

WELD WITH Tipaloy

YOUR RESISTANCE WELDING ELECTRODE NEEDS Are OUR BUSINESS

Whether it be . . . TIPS:

RODS or BARS:

SEAM WELDING WHEELS:

FORGINGS:

CASTINGS:

HOLDERS:

ADAPTERS:

SPECIAL WELDING DIES or FIXTURES: TIPALOY has them.

BUY TIPALOY and save money!

TIPALOY can supply you with:
RWMA Class #1, Tipaloy #100
RWMA Class #2, Tipaloy #130*
RWMA Class #3, Tipaloy #200
and other RWMA classes of alloys to fit your needs.

It is unwise to pay too much, but it is worse to pay too little!

Use TIPALOY and get 30% to 100% more performance for your money than you are now getting.

BUY TIPALOY and get TIPALOY QUALITY

Send your trial order today

*TIPALOY #130 cast and processed under our patents.

FREE: Write for your copy of Tipaloy's comprehensive new catalog.

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Circle No. 21 on Reader Service Card.

NEW
WEST COAST
FACTORY
DISTRIBUTORS

Complete Stock of

DURO HOLDERS AND PARTS

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Mr. K. V. Lutz

Test Duro's New DUROGON. The finest FULLY INSULATED "Tong type" Holder, light weight aluminum N3 only $6.25 list, Heavy Duty Bronze only $7.15 list, less in quantity.

THE DURO Engineering Company

31 Oregon Ave., Hamden, Conn.

BATEMAN BANTAM IRON WORKER

THE ONLY IRON WORKER OF ITS KIND ON THE MARKET TODAY

No Grinding Necessary After Cut. One Stroke Cycle Clutch Operated by Hand or Foot.

The Bateman "Bantam" cuts 2" x 2" x ¼" angles and ¼" x 4" flats. Standard punches will fit this machine. The Coper will cope 1¼" through ⅛" material. It will punch ½" hole through ¼" material. With the clutch open, the Bantam will make 44 strokes per minute. It is made of high-grade cast iron, with the clutch, pin and dog made of hardened steel. The blades are made with tool steel. It is powered with a fly wheel and gear drive, and uses a small ¾ hp motor, 1750 rpm.

Bateman Bantam with punch.....$575.00
Shear only.....$495.00
Shipping wt. 750 lbs.

BATEMAN FOUNDRY & MACHINE
MINERAL WELLS, TEXAS

Circle No. 14 on Reader Service Card.

Plastic Frame Safety Glasses

"Duo-Tone" is the name given its new "double duty" line of plastic frame safety glasses by the Sellstrom Manufacturing Co., Palatine, Illinois. That firm claims outstanding styling and safety are twin features of the line, which carries a "Series 711" designation.

The "Duo-Tone" line also provides the standard S-7 square lens shape, allowing interchangeability with present safety glasses. Both Rx prescription and plano lenses are offered. Frames are a pleasing combination of ebony and clear plastic.

Circle No. 134 on Reader Service Card.

New E6012 Electrode

Hobart 12A is a new E6012 classification electrode with iron powder added to the coating to increase the deposition rate over ordinary E6012 electrodes.

Designed for welding mild steel in the flat, vertical and overhead positions on high speed production work, it is well adapted to lap seam welds because of lack of wash-back and gouging at high amperages. The electrode is said to cause weld metal to flow smoothly and evenly to the top edge of the joint without unduly melting it away.

The use of high welding currents increase production and at the same time, low spatter characteristics, reduce clean-up time.

Hobart 12A works better on D. C. straight polarity, however, good results can be obtained with alternating current.

Circle No. 135 on Reader Service Card.

Automatic Gas-Air Blowpipe

Large area soldering operations can be effectively done now with the new Harris Calorific Company Model 89-2 blowpipe designed to burn city or natural gas, propane or butane, in combination with compressed air. Torch features leak-free brass body, sudden relighting (pilot light and hand lever), and a stainless steel burner head that has a jumbo range of flame adjustments (no need for a lot of different sizes).

Circle No. 136 on Reader Service Card.

"Button Weld" Process

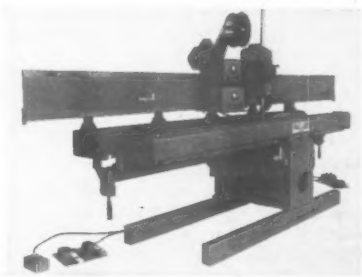
A new, low-cost method of joining steel that, in many cases, will replace or augment conventional spot welding and/or riveting operations has been introduced by A. O. Smith Corp. The finished weld resembles a rivet or button head and is made possible through a new "button weld" attachment for the company's CP-C-O Manual welding package. The attachment is expected to find wide application in welding of metals from .035- to .187-inch thick.

The process itself is a precision method of welding, according to company engineers, and uses carbon dioxide gas as a shielding agent. A consumable electrode adds filler metal to the weld. The size of the button can be changed to suit the application by varying voltage, wire feed speed, or weld current, and the number of time cycle—thus eliminating chances for operator error and giving identical welds consistently. Constant potential power gives good starting characteristics.

The system is particularly adapted for an accurately timed burn-through method of joining lighter gages of mild steel.

It can also be used as a method of tacking together heavier gage sheet and plate in place of manual arc tack welding. Another application is found in plug welding of heavier sheet metal.

Circle No. 137 on Reader Service Card.



Twin Mandrel Weld Seaming Fixture

Twin mandrel weld seaming fixtures to achieve continuous arc time, maximum production, and operational utility of one automatic welding head and power source were accomplished by Pandjiris Weldment Company, when it designed and manufactured this line of opposed double mandreled seamers with both

holding and clamping mandrels utilizing the same welding head.

While the welding cycle is taking place on one side of the fixture, the next piece to be welded is being loaded in the opposite side, thereby eliminating the production loss due to normal "down time" for loading and unloading, by continuing the weld immediately to the next piece to be welded, with loading and unloading taking place during the of the fixture.

welding cycle on the opposite hand

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wet and dry grip. The gloves are recommended for operations where sure grip is needed in the handling of greasy, oily or other slippery objects. They are coated with a blend of plastic resins and plasticizers to provide abrasion resistance, flexibility and long wear. Gloves are completely liquid-proof and stand up under most severe service.

The "Plastifab" 2-15 series comes in 6 models and includes choice of full or partial coatings. Rough texture provides resistance to wear. All gloves have an 8-ounce jersey lining.

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Semi-Automatic Welder

American Manganese Steel Division announces a new, completely redesigned semi-automatic welder for hardfacing in the shop or in the field. Light and portable, the machine is extremely simple and reliable in operation and maintenance. It is used to build up parts that cannot be hardfaced with fully automatic equipment.

The Amsco semi-automatic welder is connected to any 300 amp. or larger d-c power source and feeds hardfacing wire through a hand-held electrode holder whenever the holder switch is depressed. The holder switch also gives remote inching control as required. It is very easy to move around because of its "golf-cart" construction and large wheels.

The machine is completely enclosed to avoid shock hazards, and to protect the reel of wire. Hardfacing or build up material can be laid on continuously at a very high rate, without the waste of time or material normally required when using stick electrodes.

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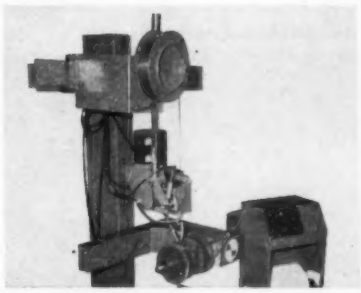

Rebuild Rollers, Idlers

An automatic, self-contained welding unit designed for resurfacing construction equipment rollers, idlers and similar parts has been announced by Automatic Welding Co. Called Micromatic, unit automatically resurfaces parts up to 48 inches in diameter, will tilt 135° to handle flange rebuilding as well as, concave, convex, or flat circumferential surfaces to no-machining tolerances. Unit includes, submerged arc head, variable speed indexing motor, positioning controls, and heat input controls, located for convenience.

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Tungsten Arc Torches

Available in both water- and air-cooled models, 10 different Vis-Arc tungsten arc torches are being marketed by K-G Equipment Co. The water-cooled torches are equipped with full ⅛-inch water passages for better cooling and better flow, virtually eliminating mineral deposit buildup in tubes.

All torches feature a "heatbreak" fiberglas washer between nozzle and the silicon rubber-insulated head. Torches are said to be durable, perfectly balanced and easy to maintain.

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Plastic Coated Gloves

A new series of plastic-coated gloves has been announced by American Optical.

The new series features non-slip

FACTS AT YOUR FINGERTIPS: *Do you want full information on the latest welding products shown on these pages? Just circle the appropriate number on the bound-in readers service card and you'll get it.*

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BENDING BLOCKS or WELDING PLATENS

Semi-steel Blocks for layout, welding assembly work, etc., with machined working surfaces; also tools and accessories, including a full line of clamps, drift pins and dogging devices. Standard and special stands can be supplied. A 4-unit set-up, joined and mounted on stands, is shown above.

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BRAZING DISSIMILAR METALS

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tral clearance which will restrict the amount of stretch in the solidified brazing alloy to a theoretical elongation of 50%, the ideal maximum. The results of this method are not exact, but do give a good starting point for a brazing a trial assembly.

The nomograph is based on the equation $\triangle C_D = D \triangle T (\alpha_2 - \alpha_1)$. This provides a working approximation of the gap change in a tube-and-socket type assembly of specified diameter and base metals, when heated from room temperature to brazing temperature. The terms of the equation are:

$\triangle C_D$ = *gap change between room and brazing temperatures, (in inches)*

D = *nominal diameter of the joint, (in inches)*

$\triangle T$ = *net difference between room temperature and solidus temperature of the brazing alloy (°F)*

α^2 = *mean value of expansion coefficient for base metal of* **female** *member over the temperature range* $\triangle T$, *(in./in./°F)*

α^1 = *mean value of expansion coefficient for base metal of* **male** *member over the temperature range* $\triangle T$, *(in./in./°F)*

Note that when α_2 is larger than α_1, C_D has a positive value, indicating that the joint gap enlarges upon heating. When α_2 is smaller than α_1, C_D has a negative value, indicating that the gap contracts on heating. Since the more serious problems with dissimilar metals arise when $\triangle C_D$ is negative, the nomograph is constructed for the situation where $(\alpha_2 - \alpha_1)$, and hence, $\triangle C_D$, have negative values.

It should be emphasized again that the theoretical percentage of elongation calculated by this nomograph may be higher than actually occurs in practice because of plastic deformation of the base metals as they cool down from brazing temperature. Therefore, where maintaining the ideal 50% theoretical elongation results in too large a gap to braze satisfactorily, try starting with a smaller room temperature clearance. Although the theoretical elongation will increase as a result, the joint strength may still be adequate for the application. In some cases a more sluggish brazing alloy will solve the problem of filling the large gap. If the substitute alloy melts at a substantially different temperature, a new $\triangle C_D$ must be determined from the nomograph based on the different solidus temperature. Certain combinations of base metals in large diameter joints may result in so large a gap change that brazing becomes impractical. The nomograph will be useful for predicting such situations.

In cases where the nomograph cannot be read with sufficient accuracy, or one of the variables is off the scale, the value for $\triangle C_D$ can be calculated by substituting the appropriate values on which the nomograph is based, i.e., $\triangle C_D = D \triangle T (\alpha_2 - \alpha_1)$ • •

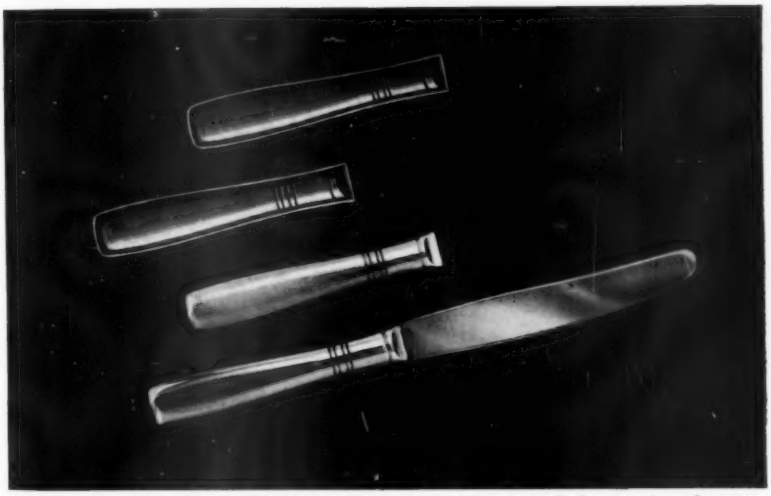
WELDING CLINIC

J. Imperati and R. F. Pulver, Welding Engineers
The American Brass Company, Waterbury, Conn.

Steel products are assembled economically with Anaconda filler metals—by brazing or braze welding

Many of the steel products encountered in our everyday lives are assembled by economical braze welding and brazing with dependable and versatile Anaconda filler metals. Among these products are home, school and office furniture, frames for wheeled toys, bicycles and portable power generators, screen and storm-sash frames, sink and refrigerator cabinets, etc.

BRAZE WELDING. The filler metals used are Anaconda-997 (Low Fuming) Bronze, Tobin Bronze®-481, and Nickel Silver-828. Their low application temperatures produce distinct advantages for oxyacetylene braze welding, such as excellent control, simple joint and fixture designs needed for efficient production, and low distortion. In addition, when molten, they easily bridge gaps in poorly fitted joints and readily build up fillets and reinforcements to develop maximum joint strengths.



TWO HALVES of stainless-steel knife handles are joined by controlled-atmosphere brazing using Anaconda Nickel Silver-828 Welding Wire at The Imperial Knife Company.

BRAZING. Most of these advantages are also available when the alloys are used for brazing in induction-heating and controlled-atmosphere furnace operations. An excellent example is the manufacture of stainless-steel handles for table knives. Imperial Knife Co. of Providence, R. I., uses Nickel Silver-828 for controlled-atmosphere brazing in production of the knife handles shown at the right, above. High-quality joints are essential for durability and good appearance, and high quality is just what this alloy confers. It develops high strength by making full-section joints, and the polished joints are inconspicuous because the alloy's color is so close to that of the steel.

The 1/16" diameter wire is cut into short lengths which are placed within the hollow handles when their two halves are assembled before entering the furnace. When the brazing temperature is reached, the molten filler metal flows by capillary action between the butted edges to bond the joint completely.

FOR MORE INFORMATION. Anaconda distributors will gladly help in the selection of the exact rod for your job. Or write for a copy of Publication B-13. Address: The American Brass Company, Waterbury 20, Conn. In Canada: Anaconda American Brass Ltd., New Toronto, Ont. 5978

SIDE OF A HOSPITAL BED being assembled at Simmons Co., Kenosha, Wisc., by braze welding with Anaconda-997 (Low Fuming) Bronze Welding Rod.

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